PROJECT MANAGEMENT

FIRST EDITION

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Last but not least, I hope that this module would be improvised annually as a student's reference during lecture.

Dedicated students Section 1 session 2017/2018

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CHAPTER 1

FUNDAMENTAL OF PROJECT MANAGEMENT

Outcome based Education:

1. Students are able to select a product with maximum components are 15.
2. Students are able to distinguish between project and project management based on their product.
3. Students are able to describe the potential of their project failure based on time, cost, scope and quality management.
4. Students are able to choose their product classification with justification.
5. Students are able to explain the impact of 6 factors towards their product.

1.1 Reversible Umbrella

Based on our observation, current design of umbrella has several flaws. One of the flaws is when the umbrella being flipped down in raining day, the outer layer is still wet. This part will make the water on the layer drop to the floor or car carpet as an example which will make those surface wet. To prevent this, reversible umbrella was designed so that the water on the canopy layer will never fall on the floor. This design will give many benefits to the user.

1.1.1 Components of Product

No.	Item	Description
1	Canopy	- It is hand sewn to the ribs in form individual panels. - The canopy cannot be cut from one piece of cloth because each panel has to be shaped according to the curve of the canopy. - Each panel is cut separately from piles of materials called gores. - Machine cutting of several layers at once is also possible to be done. - An umbrella will have up to 8 panels, 6 panels and 12 panels.
2	Rib	- Ribs run underneath the canopy of the umbrella and stretchers join the ribs with the shaft of the umbrella. - They are assembled to give a 'U' shaped to the ribs and are usually made out of steel. - The ribs are attached to the shaft by fitting it to a thin, round nylon or plastic piece with teeth around the edges and then held with thin wire. - To close the reversible umbrella however users have to pull it up instead of pulling it down.
3	Handle	- The handle is commonly made of either wood or plastic. It is fixed at the end of the shaft by either glue or screw.
4	Shaft	- Stick of the umbrella is usually made out of wood, aluminum or steel. - Its width is approximately 0.95 centimeter thick. - Wood from various ash trees, including Rowan wood from Asia, is among the popular choices for a sturdy wood shaft. - Wood shafts are usually made out of standard wood-shaping machines such as turning machines and lathes, metal and plastics shafts however can be drawn or extruded to the proper shape.

1.1.2 Differences between Project and Project Management based product

Project management
- The process of creating the umbrella is on-going as the product need to be marketed in industries. - The unique of umbrella lost because of the product are repetitive and anyone can have it. - The objective of product is to gain profit in business and to make the movement easier especially during the raining. - The company required a certain factory for the products' supply as it need to be created in abundance. - The project manager need to have many workers to make it successful.

1.1.3 The Potential of Project Failure

There are a few potential factors for project failure. This potential factors are related to how good the planning process of our project. A good process planning will ensure the success of the project. We will explain the potential of our project failure based on time, cost, quality management and scope.

Project failure based on time

The time management of the project. Every project needs a proper and a good time management. The project must follow the scheduled time. If the project fails to follow the scheduled time, it will affect the period of time for the project to finish. Thus, will influence other factors such as the cost will increase because the longer the time taken to finish the project, the higher the cost needed. Delayed process only will make the project becomes less efficient with the chain of problems related to time. For example, without adequate time to execute the project, the reversed umbrella cannot be produced in time for inspection related to quality.

Project failure based on cost

Cost is also an important aspect for ensuring a good project. Without a good cost management, the project will be handle with difficulty as we need a specific amount of money and resources to finish the project. A planning of what to do and what to buy is a good way of ensuring a good cost management. Cost management also set our project to only use resources and money on planned things. For example, the reversed umbrella requires a specific component to create it proper function such as runner. Without this component, the reversed umbrella cannot open and closed. A proper cost management will help ensuring the component are sufficient only for the project to finish. The cost to produce the reverse umbrella will influence the amount of money and resources needed. The lower the cost of creating reversed umbrella, the higher the profit of the company.

Project failure based on scope

The scope of the project needed to be well defined at the initialization phase. The scope influences the project realization. Setting up a big scope only will prompt problems toward the project. The objective and the purpose of the project needed to be understands and well known to avoid any misconception of the scope. For example, when the scopes are too broad, the target that we want to achieve are indistinct. Indistinct purpose only will make our project becomes lack of true objective. We will create reversed umbrella as to avoid the rain water from the user. Clear scope without any blurred objective. The smaller the scope of reversed umbrella, the easier to achieve the objective.

Project failure based on quality management

Quality of a product are one of the factors that are monitored by customers or consumers. To ensure a good quality of reverse umbrella, a good quality management need to be implemented at the project initialization. By making inspection and setting up a quality parameter standard can help ensuring the reverse umbrella are produced with zero defects. The quality standard needed to be standardized for the operations to maintain a good quality. For example, the component to produced reverse umbrella are inspected beforehand before the assembly process begins. A good quality component will ensure the best quality of the reverse umbrella.

1.1.4 Product Classification with Justification

Based on our project (reversible umbrella), the project type is modification. Modification is adapting existing well-tested technologies with slight improvements. A normal umbrella is used to protect us from the sun and rain. This is then modified to reversible umbrella. This reversible umbrella helps us to open and close in confined spaces. This is also is easy to handle as it is drip free and dries very fast. The reversible umbrella is also the 'Revolutionary Inside Out Umbrella' as it is modified from a normal umbrella.

1.1.5 Impact of 6 Factors Toward Project Success

Factors	Impact
Scope: Modify design Decrease number of parts used	Resources: Task given to the operator in assembling parts will decrease. Cost: Less parts use will make the cost for purchasing parts become cheaper. Time: Shorter time used to assemble the parts of reversible umbrella since lesser parts used. Performance: Give benefit to user which water will never drop to the floor when the umbrella is flipped upwards. Value: High value. Different design will attract customer.
Value: Make an advert to promote our product to increase its value	Cost: Bigger cost need to be invested in making the advertisement. Resource: More human energy need to be used, since sub-contractor is used in making the advertisement.

1.2 Bell-Shaped Umbrella

1.2.1 Components of Product

Umbrella is a collapsible shade for protection against weather consisting of fabric stretched over hinged ribs radiating from a central pole. Furthermore, the umbrella is also described as the bell-shaped or saucer-shaped largely gelatinous structure that forms the chief part of the body of most jellyfishes. Generally, the function of the umbrella is something which provides protection or covers a broad range of elements.

1.2.2 Differences between Project and Project Management based product

Umbrella is a new planned project. It is involving by some raw materials such as shaft, handle, runner, ribs, canopy, stretchers and its plastic cover. This project is under a temporary endeavor with definite beginning and ending which gives out unique output in several phases. The project is subjected to end after attaining its objectives. After achieved the objective, the project can be proposed to manager to market it. By initiating the new project in factory with enough modal and technologies, the managers can start planning the ongoing operation by executing it. Then, the experts have to monitoring and control the process. The objective is to sustain business so it is a repetitive process to gain profits. Project is a planned process with objective which has beginning and ending while the project management is a long term operation as long as it gains its profits.

1.2.3 The Potential of Project Failure

Time
Failure in manage time usually because of not following the schedule. It is supposed to follow the schedule and obey it. If the schedule is not followed, the product will cost more money and less profit.

Scope
If we use a small scope of the uses of umbrella. For example, umbrella is only to protect you from rain. The canopy part of the umbrella was made transparent. So, it just can be use during rainy weather. That type of canopy cannot block the sunlight through it. So people won't use it if it is not multipurpose.

Cost
Using high cost material to produce the umbrella. So the cost will increase. Higher cost means less profits, or hard to sell the product to users.

Quality
Connector between stretcher and rib easy to separate make the umbrella broken easily or not working properly especially when windy and rainy season. Umbrellas with low quality will not be long lasting. Customers may complain about the product which they won't use them due to low quality.

1.2.4 Product Classification with Justification

The product classification was split into four group which are mature, modification, integration and new product, ascendingly. The 'Mature" group consist of product which are made using existing and well-tested technologies. Based on a mutual understanding, our product stands in the area of 'Mature'. The basis for our previous statement is because our product has undergone multiple test in the area of durability and comfort until it was certified by our researchers for daily use by consumers of all background. Furthermore, our product was not redesigned nor was it remanufactured into another product. In other word, our product was not remodelled nor was it transitioned into another product. Our product is one of many already existing ideas that are being manufactured up to this day, to make long story-short and the product is already mass produced by other rising and already firm company. Based on the statement very earlier, this tell us that our product is made using well-tested technologies that have already existed over the years. In a sense, our product technology has 'matured'. To summarise, our product was made using the abundance of existing resource and research of other's before us.

1.2.5 Impact of 6 Factors Toward Product Success

Scope to Performance.
- The performance of product is totally depending on the weather.
- Its mean, certain of people might not use the product (umbrella) if the weather is not raining or hot.
- So the product is efficiently during rainy day or also during winter.

Time to Resources.
- The material of product is easy to get.
- The material also does not take a lot of time to search the materials.
- The process does not require so many manpower

Cost to Resources
- The cost can be affected due to the maintenance of production machines and for the workmanship.

Resources to Performance
- Faulty in product specification can affect the performance of the product.
- Careless mistake during assembling process also can lead to product rejection.

Performance to Value
- A well performing product will give great satisfaction to the users. Thus, the company will not lose the respect as well as the quality of the product is maintained.

Value to Performance
- Quality is depending on performance.
  Bad performance can spoil the good name of the company.

1.3 Hair Dryer

1.3.1 Components of Product

The product selected is hair dryer. The product is an electromechanical device designed to blow normal or hot air over damp hair to accelerate the evaporation of water particles and dry the hair. This course is about how to provide effective method of delivering products within cost, schedule and resources constraints project management gives you the skills to ensure your projects are completed on time and budget while giving the user the product as they wished.

1.3.2 Differences between Project and Project Management based Product

Project:
In project a Professional Engineer have experience do the product that industry need to improve the hair dryer technology. Next, the product can be produce at one time for one unit only and need 7 days to complete the hair dryer product. Next, for the cost produce the hair dryer project, pro duct must not exceed RM 399.90 based on the product price. Finally, project of the hair dryer must be unique by installed a new eco-technology which is portable solar hair dryer.

Project Management:
The manufacturing industry does not have to used enough professional engineer to do the hair dryer product. Besides, the product still on-going due to the industrial and the industrial only produce 5 hair dryer per month. The product cannot be produce to the industrial due to inaccurate cost. Finally, the product lost its unique due to the large production of the hair dryer.

1.3.3 The Potential of Project Failure

Time Management in Multitasking

Sometimes peoples wanted to finish their work more efficient in the shortest time. In order to do so, they will try to hold as many tasks as possible without considering the impact. This will cause their overall progress become slower as their time has been divided into many parts to solve different task. A single mistake will cause their progress being disrupt and more time is required to solve that mistake. Eventually, this will lead to a project failure as they could not finish their task before or even on the deadline.

Cost Management in Cost Forecast

Sometimes, people will underestimate the cost of a small project like the hair dryer. Inaccurate cost estimation will lead to a project failure as the resources running out when the project is still going on. This will lead to production of semi-finished product which cannot operate normally. Insufficient fund will cause the project unable to continue and thus a project will fail. For example, insufficient or underestimated fund will produce a project which have a low quality and might danger the user.

Scope Management in Scope creep

When a project is not defined properly, an uncontrolled changes and continuous growth of scope will happen. Addition of product feature which are not in the requirement or change request by the project team will lead to an extension of time on a project. As long as the addition of feature still happening, the outcome product might exceed the target cost and even require a longer time to produce a prototype.

1.3.4 Product Classification with Justification

The classification of our product is modification. Modification is a technology or idea that is same as 'mature'. The difference between mature and modification is using existing and well-tested technologies while modification is adapting existing well-tested technologies with slight improvement. The improvement that we will do are we least the sound of the hair dryer and make it more friendly – environment. The reason of improvement that we will make because many users unsatisfied towards the sound that produced disturbing their surroundings. So, we have decided to make some modification by reducing the sound. Other than that, we also make improvement towards the heat control. Most of the hair dryer easily broke down because the ability of component cannot control the heat produce for a long duration of time. The component that we will added to overcome the problem is exhaust fan. The main function of exhaust fan is remove the air and then make the air cool. By this improvement, the circulation of air will turn out the heat becoming more cool than before.

1.3.5 Impact of 6 Factors Toward Product Success

Time
Time plays a main role in a carrying out a product. When there is more time consumed for a product making, more quantity is produced also. While, less time can be rushing and the quality of product can be effected. Besides that, more time can increase the usage of machines very well where there will be more man power in doing the product. The salary also is increased if the man power increase. There will more job opportunity.

Cost
The cost is determined by the company itself. If the cost is increased, the value or quality of the product can be improved also. One can hire a extraordinary engineer with more experiences for a better result in doing the product. With more cost a good resource can be used like a good quality of material used for the product.

Performance
Good performance will use less electricity and new technology can help reduce electricity too.

Scope
Hair dryer main function is used dry one's wet hair and in this modern era there are so much specifications in it. Can use higher quality of hair dryer to maintain the temperature where the user can use the temperature according to their style and comfort. With this way one can also prevent hair damage because they know what temperature they want. In addition to it, we can also use fuse in the plug of hair dryer to prevent electric shock.

Value
When the value is increased, the cost also is increased. This is because the components in the product has higher quality and more complex components which is expensive. So the quality and value do depend on the cost of the product. Even the time also is increased if the value is increased. This is because everything has to be assembled correctly and perfectly. It also must undergo all the checking points. Good quality components are hard to find and get in industry market.

1.4 Touch Light

1.4.1 Components of Product

Component	Feature	Function
Aluminum body	Strong aluminum exterior provides both security and durability.	-The light can be adjusted to provide a pinpoint light source or a wider beam.
Electric circuit	Basic component of electric circuit: voltage source, load, conductor to connect the source and load.	SOS signal in collaboration of switch and conducting wires that connect two ends of the light bulb.
Reflector plate	A high quality plastic part, coated with a shiny aluminum layer that rests around the lamp (light bulb).	Redirects the light rays from the lamp to allow a steady light beam, which is the light you see emitting from the flashlight.
Plastic core	To assure in them durable and lasting performance value.	Fix position of plano-convex lens.
Plastic battery case	Plastic material to have a lighter weight.	Location of batteries.
Spring terminal with cap	A thin spring or strip of metal usually made of copper or brass is located throughout the flashlight.	To ensure the circuit is always connected securely n maximizing contact surface area with the terminal of best performance.
Tactical string	Light weight.	Easy to bring and hold.
Press switch with rubber cap	Easy to configure**.**	A switch allows the user to turn on the torch light only when necessary, thus conserving electric energy.
Plano-convex lens	Glass are less susceptible to scratches, thus are preferred over the plastic counterpart.	Allows lights to pass through.
LED Bulb	Low power requirement as it can be operated with battery power supplies.	- Light source.

1.4.2 Differences between Project and Project Management based product

Aspect	Project	Project Management
Team	Collaboration of people who usually does not work together or are from different organization to produce the flashlight.	Involves people who are expertise in their own field; strong team works in order to ensure the smoothness production of the flashlights.
Timeline	Definite timeline and have start and end (temporary).	Ongoing operation (repetitive).
Resources	Limited resource of capital and man power.	Controlled include developing budgets and finance.
Activities	Developing the new flashlight or modified existing flashlight to meet the new requirements.	Process of planning, scheduling and controlling the productions of flashlights.

1.4.3 The Potential of Project Failure

Cost of product:
It depends on cost of materials used, machine maintenance cost and profit. The cost of flashlight might be increased due to the factors of production which is capital, labor and taxation. The profit of flashlight is not in rational expectation because of its market value and market price. The indirect cost in long term run is needed like machine maintenance cost to maximize the production output. The increasing of cost product will lead to project failure.

Time management:
A failed project in flashlight may be influenced by inaccurate estimation of production time planning. The percentage of failure in production is directly influenced by the employee productivity. There is also a direct connection between efficiency of machines and production goals. The longer of time spent in production causes project failed in expectation.

Quality management:
The quality of flashlight may not in standard because of quality of materials, performance of employee and production lines in company. The employees' skills and behaviour cause the output product may not achieved the Standard Operation Procedure (SOP). The employer may purchase lower price of materials without considering the quality of materials to the flashlight. The production lines leader does not monitor the manufacturing process that is directly linked to the quality of end product. Thus, poor of quality management may lead project failure.

Project scope:
The project tasks may fail due to unexpected factors such as natural disasters. The production lines in manufacturing factory may be decreased due to machines break down. In addition, there is possibility of accidents occur for example flood, injury of workers and electricity supply. The determination of project scope is directly affect the failure of project.

1.4.4 Product Classification with Justification

The product that we have chosen is an existed product and a well-tested technology, even though it is an existed technology, we didn't make any slight improvement on it. We also didn't integrate the existed product. Thus, it concludes that the product classification we choose for our project is mature project.

1.4.5 Impact of 6 Factors Toward Project Success

First factor that give impact to our project would be the project scope, If the scope of our flashlight would be decreased, our time to produce the flashlight is low, and the cost for the flashlight component will be reduced, we were also able to increase the performance of the flashlight, resources of needed also will be decreased, the value of the flashlight will increase due to low cost of product and have better performance on it.

The second of the factor would be the time. When the time to complete the project is low, the cost would be lower, due to that, the value of our flashlight will increase, the resources that we need for the flashlight will be decreased. Thus, the scope will be lower.

The third factor is the product's cost. Low product cost would be better. It is because the value is higher, the time needed to complete also will be low, the performance of the flashlight will be increased due to lower resources needed for the flashlight. The scope will be lower due to the cost.

The fourth factor is resources, if low resources needed, the cost of the flashlight will be low. The process time will be low, the performance of the flashlight will be increased, the value of the flashlight will be increased. The scope of the project flashlight will be increased.

The fifth factor is the performance of the flashlight. If the time of manufacturing process decrease, the performance of the flashlights would be increased. It will lead to the raise of value of the flashlights due to high performance. As the resources needed reduce, the cost needed would be decreased too. Therefore, the scope of the flashlights will be increased.

The sixth factor that could give an impact to our product is the value of the product. Higher quality of resources usage will bring on better performance of the flashlights. Thus, the scope of the flashlights will be high. However, the cost of the product would be increased at the same time.

1.5 USB Fan

1.5.1 Components of Product

1.5.2 Differences between Project and Project Management based Product

Project
- ❖ Unique and temporary endeavors with a specific reason (business need, market demand).
- ❖ Short duration.
- ❖ Ended once the project is finished.
- ❖ Example: A special promotion to highlight the product sold to customer's favor by offering a free battery to every purchase.

Project management
- ❖ It is an ongoing process.
- ❖ Repetitive activities (accounting, production).
- ❖ Application of knowledge and skills to fulfill company's requirement (product-making).
- ❖ Handles company scope, resources and risk.
- ❖ Example: Ccontinuous process required to sustain the business of a company by producing the main selling product of the company.

1.5.3 The Potential of Project Failure

Time management
- ❖ Overwhelmed feeling. This feeling is usually caused by one or two things. The first is that people think they have to do everything, assuming that more is better. The best way to solve this problem is to focus on achieving just a few things not everything. Prioritize and learn to say no to anything that is not on your short list.
- ❖ Not finishing what we started. Working on a project, but not bringing it to completion, is usually a big waste of time. Moreover, since the product we do is for somebody else, not only we need to finish what we start, we also have to hand it off to the next person in such a way that they understand the value of what we have done.

Cost management
- ❖ Failure in cost estimation. As we know cost estimation is the key function in every project construction. All the customers will look for a product which is worth paying. So that the cost estimation for a product is very important in order to sustain any project businesses.

Scope management
- ❖ Fail to follow the scope given. When the workers failed to follow the plan that already made within the time frame and budget allocated, the production of USB fan will have some issue in finishing the product. Part of the planning process is not preparing some inevitable fact that, once the project starts, the workers may make some mistake and they do not prepare for the inevitable fact. If they don't, they will end up trying to complete more work than what was originally agreed to and budgeted for. In other words, they will be heading down the road to trouble. Other than that, some workers recognize large scope changes but are not as diligent on smaller changes. There is a tendency to just go ahead and add the additional work without too much thought. When all these small changes are combined, the workers realize that has taken on too much extra work and can no longer make within the time frame.

Quality management
- ❖ Failure in quality planning. The potential failure in this project is the manufacturing process. There has 2 process, the plastic process (housing) and the electronic process. To make this project achieve a desired goal, the planning team has to make sure there no mistake in their plan. If there are any mistakes it can be costly to fix them.

1.5.4 Product Classification with Justification

- ➢ The product that we choose that is USB fan is classified as MODIFICATION product because the product is adapting existing well-tested technologies with slight improvements. Before improvements are made, this product works by battery and it is not lasting. Therefore, there are some slight improvements made to this product that is from the use of batteries to USB usage. Design and size are also changed to attract customers.
- ➢ After some slight improvements are made, the USB fan is more compact and flexible with a 2.0 standard USB 2.0 connector that is compatible to a wide variety of gadgets. Besides, it is extremely energy efficient and practical, no batteries are needed. Simply plug it to your laptop or powerbank and keep cool while working on any laptop or tablet.

1.5.5 Impact of 6 Factors Toward Project Success

Resources: The resources for USB fans are easy to get so the company can save their time in producing the product and optimize the duration.
Scope: If the components used in producing this product are higher quality then the price per unit will also be expensive because the scope of making the product are lower and the time needed is higher.
Cost: An USB fan is the fan that makes use of a USB port as power supply, the component used in producing USB fan is not expensive so the price per unit for this product is affordable for all.
Time: The time taken to produce this product is not very long because of its resources are easy to get by the suppliers at low price.
Performances: USB fan are small in size and easy to carry to everywhere. Hence, this product is suitable for all.
Values: USB fan is a value product that can be afford by every range of the communities from student to corporation executive.

1.6 Thermos Flask

1.6.1 Components of Product

1.6.2 Differences between Project and Project Management based Product

Project:
Mr. Tan brings a bottle of hot water by using thermos flask during a cold day. When he pours it out and drink the water, he realise that the water is not hot enough although just passed a few hours. Hence, he decides to make a higher heat preservation thermos flask by creating a new project in his company.

Project Management:
Mr Tan employs some professional engineers to mass produce a high quality thermos flask. Furthermore, Mr Tan also employ many workers to create a more attractive and high quality thermos flask. These workers have also been employed to do research on how to improve the time of heat preservation of the thermos flask.

1.6.3 The Potential of Project Failure

Time
If we do not follow the monitoring systems, measurement time, and equipment schedules, the project might not be able to be finished by the deadline and the work becomes more complicated because there is no time to use any machine that can make a lot of trouble to workers. Furthermore, there is no opportunity to recheck the product for any problems. So, the potential of failure of the project is higher.

Cost
The project will fail if we did not consider all of the project's cost properly from the beginning until it is done. There are some problems that can cause failure to our project, that is when we spend over the budget because did not clearly understood the necessary components and use a lot of money to fix unnecessary things. All of the problems actually can be a big problem and make our project stop from progressing because we do not have enough money to support the project.

Scope
Basically the projects will fail if we do not control the scope properly because the worker's will miss understand their task and the miss communication in the project. The project will not be running effectively and make the project uncontrolled and the pressure of a tight deadline combined with constant requirement changes lack of technical specification and the need for innovation these things can kill any project.

Quality
The project can be fail if no one understood the defined of their goals and strategies because if the order is not clear on project priorities, then it follows that the entire organization is also unclear about which projects are the most important. If project priorities are not clearly established, then it is highly likely that the organization will embark upon too many projects at one time. Once these elements are outlined, many projects are eliminated for not matching up to those goals.

1.6.4 Product Classification with Justification

Thermos vacuum flask is a durable product which is used for long periods of time. A durable product is a product that does not quickly wear out, or more specifically, one that yields utility over time rather than being completely consumed in one use. Thermos vacuum flask can be used repeatedly and use for many years. For example, one of the brand of thermos, Hydro Flask, it is durable and light, making it easy for you to carry around at your convenience but the cost of this brand will be more expensive as the capacity to keep the drinks cold up to 24 hours and hot up to 6 hours. So the quality of this brand will be better than other brands, and need more time to produce it.

1.6.5 Impact of 6 Factors Toward Project Success

The first factor is scope. It impacts the products outcome as it effects all variables which can alter everything. It can make the time span of making components be shorter than expected as there are less components to make. When it comes to cost, the scope makes it sure that the budget is properly allocated meaning not to overspend or pay less than exact agreement to allow smooth movement of the project. Scope can keep track of the overall performance of project as it can either ensure everything is going as planned or the tasks are delaying the project as everything is managed. Scope makes sure the resources are properly distributed to make sure the components are accordingly made from the resources to their approximate requirements.

The next factor is time. Time plays a major role as it either make the cost higher by shortening the time taken to do the project or affecting the cost to be lower. When it comes to scope time makes it that the time span of doing things for the project is kept in order as to allow efficient progress to be made. Time effects resources by making it more being used for example more labour work or less being used to make progress. Usually as the more time taken to the project the more the project achieves the targeted value of the product.

Afterwards is cost as the third factor. With a higher cost being used for the project it affects the time being much shorter and this is also true for the opposite with low cost having more time. Cost influences the scope by making sure that the expected scope is properly achieved by making sure all expenses are met without hiccups. The cost being used is proportional to the performance of the project as it makes sure that all desired aspects are secured as more cost increases the performance.

The most important factor is time. The time means the deadline for the project or the time taken to finish a project. When the time decreases, the cost of the project will be increased. The company needs more manpower to process their product so they have to pay more to employ the works. Besides, the other impact of the time is the scope. The scope of the project means the needs to be achieved and the work that must be done to deliver the project such as the function, tasks and the others. As time decreases so will the scope of the project decrease. That is because it will increase the works of the workers and this will cause them to be unable to focus because they have to solve a lot of problem in a short time, so they cannot fulfil the target for their project. Resources also is one of the impact of the factors. The resources include the manpower, material, machine and so on. The decreasing of the time will increase the resources. The company has to employ more manpower and buy more machines so they can reach their target in a short time. The other impact will be the value. The value can be defined as the quality of the product. The time decreasing will also decrease the value of the product. For example, a thermos bottle needs 30 minutes to be produced, but when they decrease the time, the thermos bottle cannot be produced perfectly so the value will also be decreased.

1.7 Portable Fan

1.7.1 Components of Product

The product that we choose to be our assignment of project management which is portable fan. This is because the cost of the portable fan which is very low and we can sales it at the higher price. In addition, we have found on the website that in six months ago the sales of the portable fan which is amount 69934. The portable fan is made up with ten components only which is button, wire, screw, motor, blade fan, chassis fan, holder, rubber, spring and LED. Actually, the portable fan is very easy to carry and we can use the power bank to drive it and we no need to find the plug to let the portable fan running. The process of the portable fan running is electrical energy change to the kinetic energy.

1.7.2 Differences between Project and Project Management based Product

Project
We have the new idea to create something to make us colder in the hot day. First we planning to make a unique portable fan. We have planning the design and we had also set our budgets and our time to make the portable fan. After we planning all the things we started to do our portable fan. We also reduce the problem that we face. Lastly, we had successful created the portable fan

Project Management
Project management is about the product that we do to keep going and repetitive. Now we have the new idea to create the portable fan to solve the problem that a lot of people feeling hot. So we have the planning to make the portable fan because the portable fan is very easy to bring anywhere. After that, we have planning the design to make sure that the portable fan has the big wind. After we planning, we have been executing to do the fan and we started put our project plans into action. We have also controlling our project to ensure that the project is moving along as we planned. Lastly we have already created the fan, we are keep going to create the fan and sale at the outside to do our business.

1.7.3 The Potential of Project Failure

Time
If the time management for finished the portable fan project is managed poorly. The project will not finish by the time that have been schedule in the planning. So, that will be a possibility for clients to cancel it and the project will be failed.

Cost
The cost management on our project is poorly managed. We spend on not necessary resources and component such as buy two motor for our portable fan. So, we will not have enough budget to buy other component to finish our portable fan project.

Scope
Our portable fan is made from plastic. If suddenly the client wants portable fan from steel. So, it is out from our scope then the project will unsuccessful.

Quality
When our quality management is poor, our product will does not have quality. So, its value will be decrease and our clients will reject our portable fan product.

1.7.4 Product Classification with Justification

Modification: The fan has already created but we wanted to improve to become portable. It can be use anywhere without using a plug. We only use the power supply from the battery to let the portable fan running.

1.7.5 Impact of 6 Factors Toward Project Success

When the cost is lower…

1) Resources
We may have not enough resources on our portable fan project because we cannot afford a complete component for our project due to the low budget that we have.

2) Performance
The performance of portable fan will be reduced because we use a low quality resources and materials on our portable fan project such as a low quality fan blade. So, it will be easy to be broken.

3) Value
The value increase because we usually sell to the student. The student always chooses the cheaper things. When cost is low, we can sell the product at low price. So, many students will buy it.

4) Time
The period to finish this project will become longer as we have small amount of workers. It because we want to lower our cost of workers. So we only hired small group of workers.

5)Scope
When the cost is lower our scope will become decrease. Because we do not have enough budget to increase the scope of our portable fan project.

1.8 Cupboard

1.8.1 Components of Product

The product that our group has chosen is a Cupboard. It consists of approximately 7 components.

1.8.2 Differences between Project and Project Management based Product

The production of a cupboard can be considered as a "Project" if a cupboard is designed uniquely from scratch and is produced using carefully allocated budget and resources and set to be finished within a set period of time. Besides that, the production of a cupboard can be considered a "Project Management" if a cupboard is produced as part of a mass production of identical cupboards with consistent quality whereby, they are continuously produced for the sole purpose of profit.

1.8.3 The Potential of Project Failure

The product of choice is a "Cupboard". Factors such as Time, Cost, Scope and Quality Management can lead to the failure of the product. The potential of failure from the aspect of time is that, there is a risk that the cupboard is not completed on time or within the allocated time limit. Therefore, the product can be considered a failure.

In terms of costs, a project can be considered a failure if the expenditure sums up to be more than the allocated budget. The price of some materials and components tend to vary, without proper surveying of materials the expenditure may be more than the intended.

Next, the scope of the project can also lead to the failure of a product. The scope of the project is essential in ensuring the success of the product. Every detail from the allocated costs, function and design of the cupboard and the due time must be followed accordingly in order to prevent failure of product.

Finally, Quality management is important to ensure the produced cupboard is of maximum value. If the quality of the cupboard is poorly managed there is possibility the end product will be defective making it impossible to market it. A failure resulting in loss of profit.

1.8.4 Product Classification with Justification

A Cupboard can be classified as a "Mature" project. To justify, a cupboard is mostly made using woodwork and occasionally some metalwork. These processes are traditional, existing and well tested technologies. These processes basically involve nailing, knocking, drilling, filing, polishing etc. However, it is possible to "Integrate" modern technologies such as improving the materials for the Cupboard to last longer or altering the design for more stability.

1.8.5 Impact of 6 Factors Toward Project Success

If the scope is narrowed eg: budget is decreased, due time is brought forward. The time taken to complete the Cupboard will be quicker. And it will cost less to produce the Cupboard, however the performance would decrease due to budget constraint, more resources would have to be used and the value of the end product would be lower than expected. If the scope is widened, a longer time can be taken to complete the Cupboard, It will cost a little more, performance would increase as the allocated resources would be more and a Cupboard with higher value can be produced.

If the time is lengthened the costs will increase as the scope would have to be widened to accommodate the increase in time. Less resources would have to be used. A "Cupboard with high value can be produced as there is more time to focus on the quality of the product. If the time is shortened the costs will decrease as the budget will be restrained. The scope would have to be narrowed in terms of functionality and schedule. More resources would have to be used and a lower value "Cupboard" would be produced.

Increase in costs or expenditure, results in longer time required to produce the Cupboard, the scope will be modified to ensure the allocated budget is put into full use in the production of the "Cupboard". Performance will increase to make sure production is on schedule, more resources will be used as the project would be at a larger scale. A higher value and a higher quality Cupboard can be produced. If the costs is decreased, the Cupboard can be completed in a shorter period. The scope would have to be narrowed to ensure maximum profit. The performance would be smoother due to the project being smaller in scale. Lesser resources would be needed to complete the "Cupboard". However, the end product may be of a lower value.

Increasing the resources, may result in shorter period of time to complete the "Cupboard". It is possible to widen the scope a little to ensure efficient use of the allocated resources. Performance would be smoother. Although the Cupboard produced would be of a higher value, the costs would be more. Decreasing the resources used, may cause a longer time to be needed, the scope would have to be narrowed, as there is a risk of running out of resources. Performances would not be smooth. Although the costs will be cheaper the end product would be lower in value.

When the production is performing well, it would require lesser time to complete the Cupboard. The scope can be increased to maximize profit. Costs can be saved, less resources would be required and a high value end product can be produced. When the performance is not smooth. It would take a longer time to complete. The scope would have to be narrowed to prevent loss in profit. It will cost more and more resources would have to be used. The end product would be of a lower value.

For a higher value Cupboard to be produced. The scope has to be wide in terms of functionality and schedule. The product has to be completed in a shorter period. The expenditure must be less and so the resources used. The production performance must be smooth. A lower value "Cupboard" is the result of a narrow scope. The time taken to complete must be off schedule and less resources were used and the expenditure would have been less. The performance of the production would be bad.

CHAPTER 2

MANAGEMENT TOOLS

Outcome based Education:

1. Students are able to apply at least 11 of common management tools such as Brainstorming, Thought Process Mapping (TMAP), Quality Function Deployment (QFD), Kano model, Affinity diagram, Fishbone diagram, Pareto chart, Nominal Group technique (NGT), Delphi technique, Check Sheet and Strength, Weakness, Opportunity, Threat (SWOT) analysis toward their product.

2.1 Reversible Umbrella

2.1.1 Brainstorming

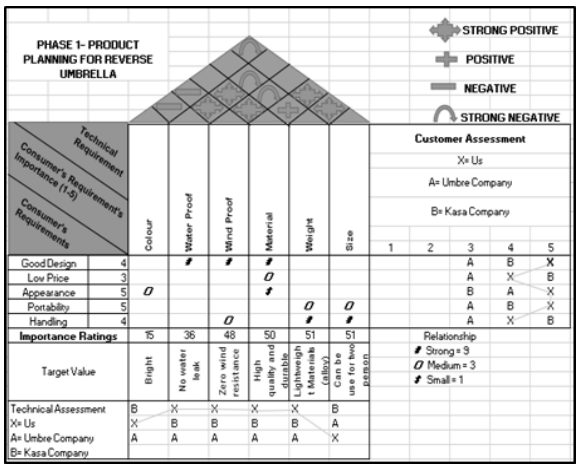
The list below is the ideas to eliminate some of the old umbrella's flaws:

- Make rib from super elastic and reliable material.
- Add some bearing to their runner, this for reliability and smooth experience.
- Use thicker and anti-tear fabric for the canopy.
- Use alloy instead of aluminum for the main tube.
- Make the tip more wider for others people safety.
- Use anti rust material for making bottom spring.
- Invent more ergonomic design for crook handle.
- Use the fabric that dry faster after being used.

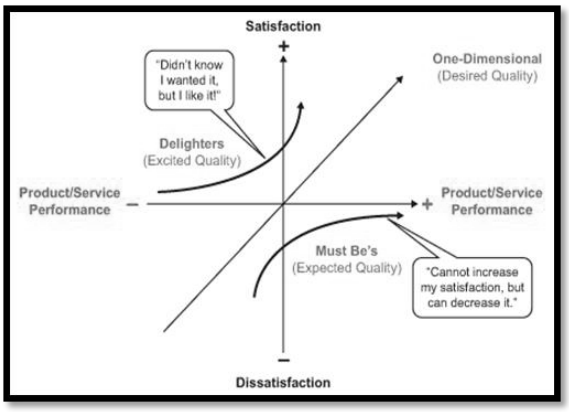
2.1.2 TMAP

2.1.3 QFD

The purpose of QFD is to determine what the product need to accomplish to satisfy and delight the customers. QFD listens to the voice of customer and then responding to the customer's expectation. The QFD are created to look for the aim of our reverse umbrella. The QFD use are shown as below.



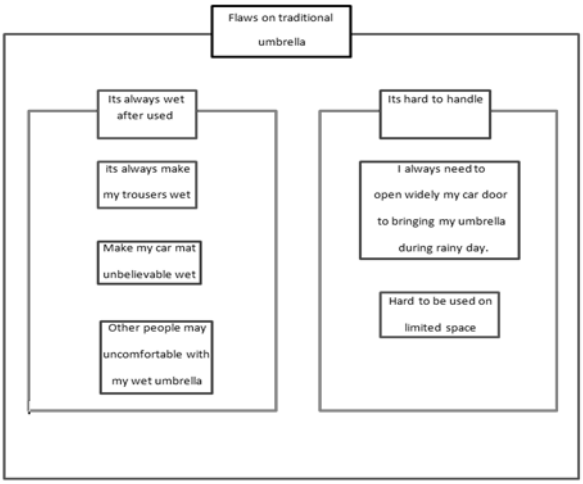
2.1.4 Kano Model



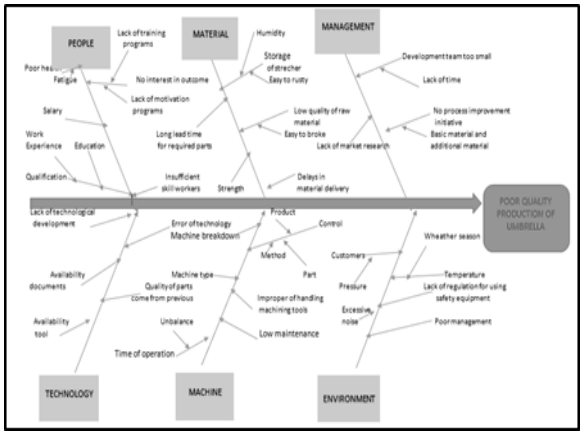
In satisfying customer's basic needs, our product's function is still the same with the old design of umbrella which is protecting people from getting wet in raining day. Besides, both old and new design of umbrella also can give shades to people while walking under the sun.

In satisfying customer's expectation, we make a bit difference which is the canopy of the umbrella will flip upwards when it is close. The benefit is the water from the canopy will not fall onto floor when entering building or home. In exceeding customer's expectation, we will produce umbrella with material that glowing in the dark.

2.1.5 Affinity Diagram



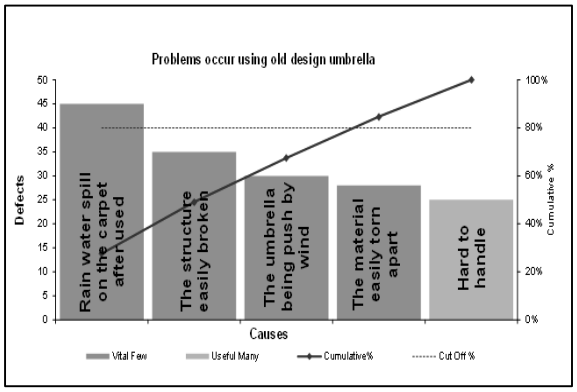
2.1.6 Fishbone Diagram



2.1.7 Pareto Chart

Pareto are used to detect the factor that have greatest impact for the reverse umbrella. By using Pareto, we can easily identify the problem

and can focus on the main factor. The Pareto diagram is used as shown below.



2.1.8 NGT

Member	Finding Suppliers	Design New Styles	Promoting Goods
Hazim	1	3	2
Aserap	5	4	3
Syazra	4	2	4
Sheva	2	2	4
Alif	3	1	3
Faiz	3	2	3
Sahana	2	2	4
Totals	20	16	23

2.1.9 Delphi Technique

Research Area	Priority for development of an improved evidence base	Comments including any particular topics or actions
Identifying the marketing	1 2 3 4 5	
Simplifying the design	1 2 3 4 5	
Identifying the brittleness of the material	1 2 3 4 5	

2.1.10 Check Sheet

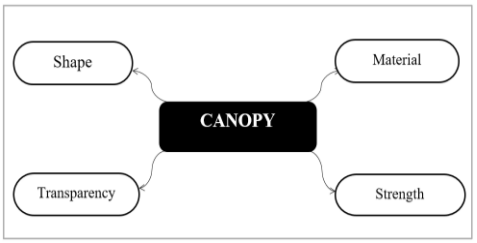
DEFECT	SYMBOL	COUNT
RUSTY		III
SCRATCHES		~~IIII~~ II
THE MATERIAL TORN		~~III~~ III
THE STICK BROKE		IIII

2.1.11 SWOT Analysis

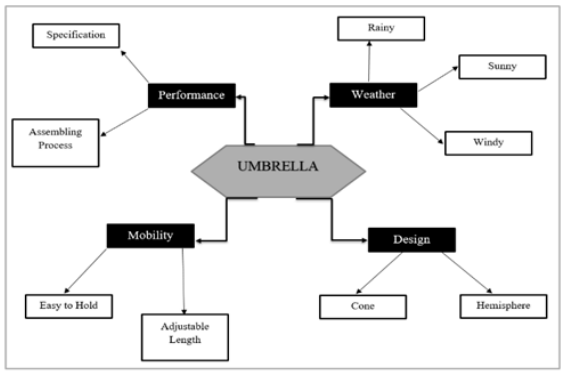
SWOT	HELPFUL	HARMFUL
INTERNAL	STRENGTHS • It also solves the problem of poking passers-by in the head with an umbrella's spokes because it opens from the top rather than the bottom.	WEAKNESS • People not knowing about the new trendy umbrella (reversible umbrella). • Cannot keep inside bags since it cannot be folded to smaller parts.
EXTERNAL	OPPORTUNITIES • Concern about comfort of handling • Concern about more new trends or even more developed umbrella • More demand for the reversible umbrella since its easily dries.	THREATS • The value of the product is high compared to the normal. Therefore, less people buys reversible umbrella (economy). • Developers creates more specialized umbrella.

2.2 Bell-Shaped Umbrella

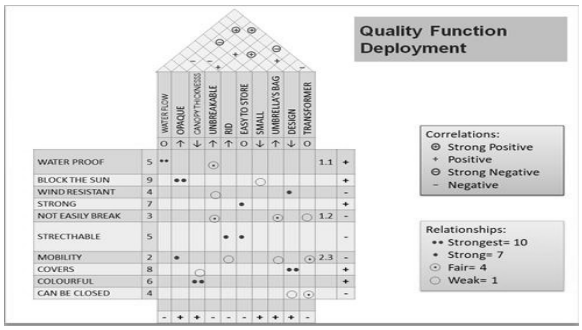
2.2.1 Brainstorming



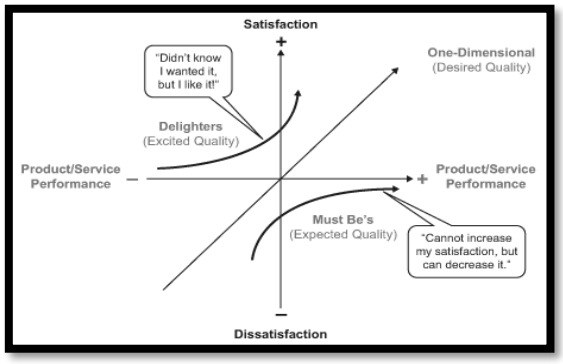
2.2.2 TMAP



2.2.3 QFD



2.2.4 Kano Model

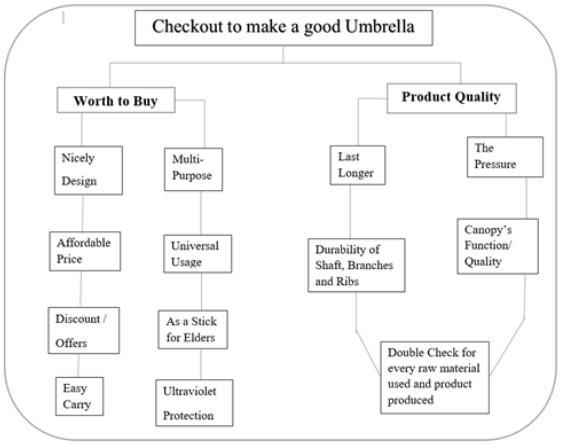


Kano Model is mainly talk about the satisfaction of customers based on the product (umbrella) performance. It involved 3 categories that is people who dissatisfy, satisfiers and delighters based on our product (umbrella).

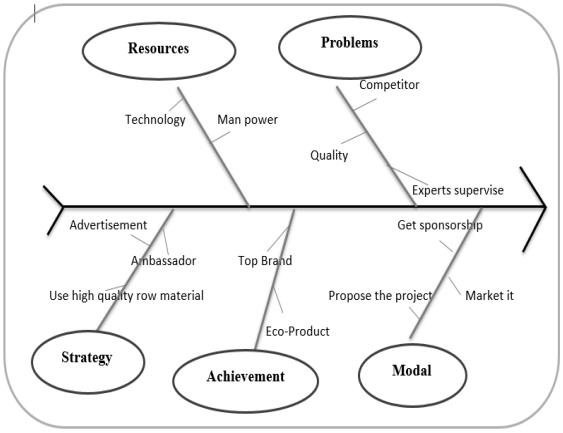
Dissatisfies	It is the level one process. For example, the basic usage of an umbrella is to protect us from the bad weathers. Therefore, the making of an umbrella must be have this function to fulfill customer's minimum satisfaction.
Satisfiers	It is a level two process. The expectation of the customer towards our product (umbrella) is affordable with a reasonable price and it is foldable that classified as easy carry tool which is the expectation from the customers.
Delighters	It is a level three process. Extra performance is installed in umbrella so that our product is unique and different from others. For example, canopy with UV protection and professionally designed. Besides that, the uses of durable raw material will cause the product o last longer, thus we can get some award in some competitions so we classified ourselves as TOP BRAND umbrella.

Furthermore, we can sell our product with discounts and offers. All of the above methods that we done, is something out of the customer's expectation and our customer will feel very delightful.

2.2.5 Affinity Diagram



2.2.6 Fishbone Diagram



2.2.7 Pareto Chart

2.2.8 NGT

	Suppliers Found	Hired Manufacturers	Design Specialist
Vishnu	7	3	4
Mimie	5	2	3
Adam	6	4	4
Puhanes	8	5	6
Wai Kit	8	7	1
Rizal	4	2	2
Ameer	4	4	2
Syazwan	2	5	4
Sum	**44**	**32**	**26**

2.2.9 Delphi Technique

Efficiency in Delivery Time	*Adam*	*Wai Kit*	*Vishnu*	*Ameer*	*Puhanes*	Comments
Use better courier services	3	5	1	4	2	Offered new dependable courier
Update server services	4	1	2	5	3	Use better servers libraries
Hire new manufacturers	5	2	4	1	3	Hire more dependable engineers

2.2.10 Check sheet

DEFECT TYPE	SYMBOL	COUNT
TORN/ BROKE	△	6
RUST	□	3
SCRATCH	○	11

NUMBER SHEET: 2
PAINT BATCH NUMBER: 23
PAINT OPERATOR: MAN
DATE: 20/9/17

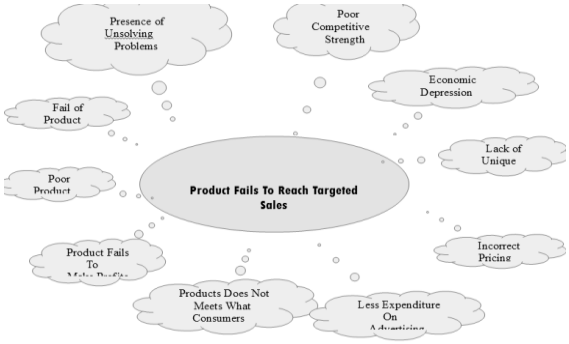
2.2.11 SWOT Analysis

STRENGTH	WEAKNESS
• Low cost of innovation and manufacturing • High quality of the product • Many variety of umbrellas	• Lack of established reputation • Not easily get dry
OPPORTUNITIES	**THREATS**
• Concern about fashion (new trends) • Concern about security and comfort	• Good facility to buy an umbrella wherever we go • Entrance of new competitor • Economy status

2.3 Hair Dryer

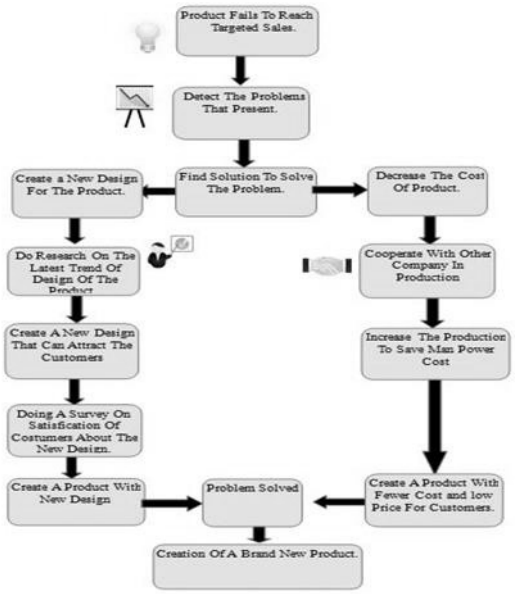
2.3.1 Brainstorming

A process for teams to generate ideas and to find solutions on project issues. In hairdryer project, brainstorming is applied in team member to generate idea on "Product Fails to Reach Targeted Sales". There is some factor for the product fails to reach targeted sales that is presence of unsolving problems, poor competitive, economic depression, lack of unique features in the hair dryer products, incorrect pricing, less expenditure on advertising, products do not meet what consumers, product fails to make profits, poor product and fail of product.



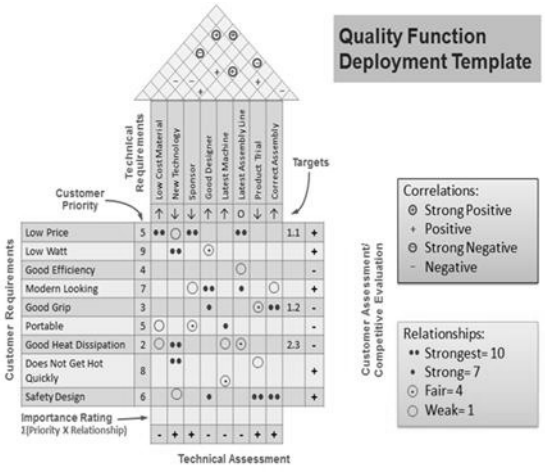
2.3.2 TMAP

The thought process map is a graphical representation of a series of ideas of a person or a team. TMAP is applied in product fails to reach targeted sales idea and how to counter the problem faced by the company.



2.3.3 QFD

QFD is a tool that links customer requirements to project planning, analysis, design and implementation. Figure 3 show how the Quality Functional Deployment is used. This technique is based on the customer requirement and technical requirements. The customer requirement on hair dryer which is low price, low watt, good efficiency, modern looking, good grip, portable, good heat dissipation, does not get hot quickly and safety design. For the technical requirements is a low cost material, new technology, sponsor, good designer, latest machine, latest assembly line, product trial and correct assembly.



2.3.4 Kano Model

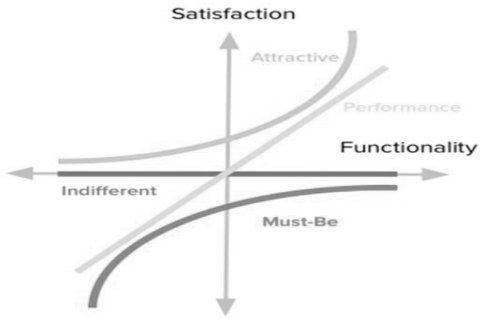
Kano Model is a tools in management to distinguish types of product requirements that influence customer satisfaction.

Satisfaction – The customers were satisfied with the product because the product is good. This is due to the 5 years of warranty that had stated for the product that gave the customers easily to change or fix the product.

Impressed – The customers were impressed with the product due to the quality of that product. It can be used for a long time period like 4 years and above.

Must-Be – The customers expected the improvements of the product such as reduce the sound of hair dryer. They also wanted the company to sell the product based on the quality and improvements of the product.

Dissatisfaction – The customers did not satisfy with the products because the company said that there would be 2 heat converters attached to the product but it was completely wrong. The customer has one heat converter only.

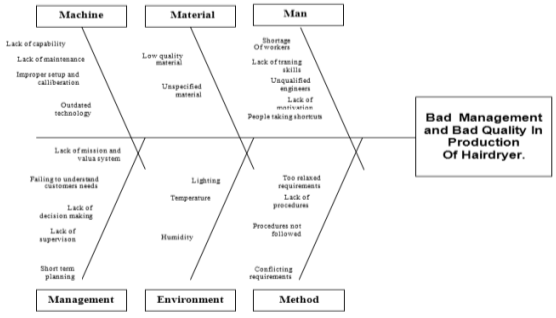


2.3.5 Affinity Diagram

Affinity diagram is applied to make a good step for good quality and good management in production of hairdryer.

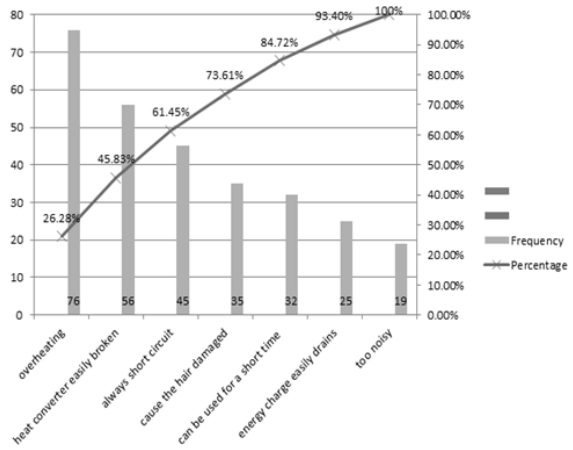
2.3.6 Fishbone Diagram

For the fishbone diagram is a tool that allows teams to identify and graphically detail all possible causes related to a problem and discover root causes of the problem at hand.



2.3.7 Pareto Chart

Pareto chart is a bar graph where y-axis represents frequency of occurrence. In this Pareto chart survey had been made and data had been collect. The aspect that is consider in this data by usage of hairdryer. Some hair dryer is overheating, heat converter easily broken, always short circuit, cause the hair damage, can be used in short time, energy charge easily drains and finally is too noisy of product.



2.3.8 NGT

Based on the nominal group technique is a group process involving problem identification, solution generation, and decision making. After making some votes, the data was taken into the account and the largest group is considered, the data is ranked from first to last. In the Table 1 showed the largest data recorded is hire new purchasing agent for our company to reduce the cost of product resources in making hair dryer. The 2nd is create new design and finally 3rd is evaluate new supplier. By applying this technique, the most ideal from brainstorming with group of expert in this field to get the lowest cost in materials components of hair dryer.

	Evaluate New Supplier	Hire New Purchasing Agent	Create New Design
Nawawi	3	3	4
AmalAsri	3	2	2
Wei Ming	4	4	3
Tharsyini	2	3	4
Shahida	1	4	2
Totals	13	16	15

2.3.9 Delphi Technique

The Delphi technique is a structured communication technique or method, originally developed as a systematic, interactive forecasting method which relies on a panel of experts. The experts answer questionnaires in two or more rounds. After each round, a facilitator or change agent provides an anonymized summary of the experts' forecasts from the previous round as well as the reasons they provided for their judgments. Thus, experts are encouraged to revise their earlier answers in light of the replies of other members of their panel. Delphi technique is applied for hair dryer product to improve already our company product and making some improvement on management product.

Research area	PRIORITY for development	Comments including any particularly important topics for action
Improving the design of hair dryer.	3	
Installing the new eco-technology in hair dryer(solar technology)	2	
Identify the factors of delay production not same like schedule.	5	Not enough worker and make 24 hrs production.
Identify the factors of increase cost and quality	4	Cost increase due to hiring expert engineer for making a perfect quality.
Identify the factors for making smaller scope in making hair dryer product	2	

2.3.10 Check Sheet

The check sheet is used in form to allow a team to systematically record data from historical sources as they happen in real time. In the hair dryer project the check sheet is used in data record on reason for hair damage before using hair dryer, the most reason for hair damage is frequently washing their hair.

CHECKSHEET

REASON FOR HAIR DAMAGE BEFORE USING HAIR DRYER

Name of data recorder : PUTRI NUR SHAHIDA
Location : UNIVERSITY MALAYSIA PAHANG , PEKAN
Collection dates : 13/9/2017 - 20/9 /2017

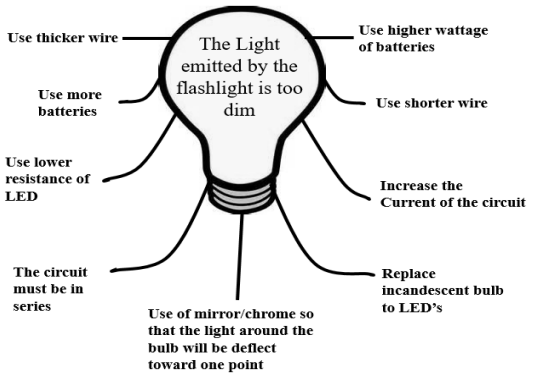
Reason	13/9	14/9	15/9	16/9	17/9	18/9	20/9	Total
Frequent washing	II	II	III	III	IIII	IIII I	IIII II	25
Brushing Wet Hair	II	II	IIII	III	IIII	III	IIII	22
Towel Drying	II	II	III	IIII	II	III	IIII	20
Blow Drying		I		I		I		3
Flat irons			I		I			2
Total	6	7	11	11	11	12	14	72

2.3.11 SWOT Analysis

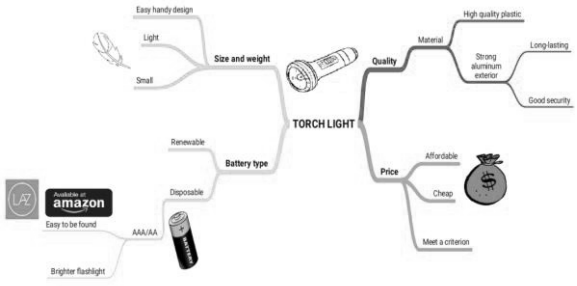
STRENGTHS	WEAKNESSES
Hair dryer just have in town or it might be located in a spot that attracts a lot of business. Great flexibility and ease of transport with using hair dryer.	Seller have the worst location in village. A great number of consumers prefer to buy hair dryer by purchasing through Internet rather than visiting the market. Hair dryer does not longer-lasting so, hair damage can occur.
OPPORTUNITIES	**THREATS**
Seller will increase the quality of hair dryer brands. Selling ionic hair dryers which can help speed up the drying process. Selling on the Internet allows taking orders around the clock on every day of the week.	Competition between hair dryer brands in different cost such as Pensonic, Panasonic, Samsung, Haier, Remington and the others. All brands of hair dryers have different qualities.

2.4 Touch Light

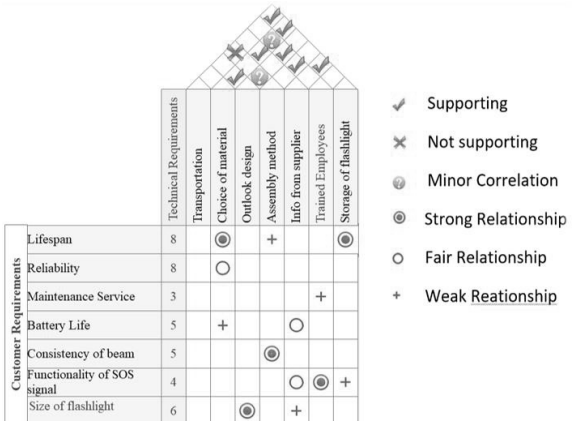
2.4.1 Brainstorming



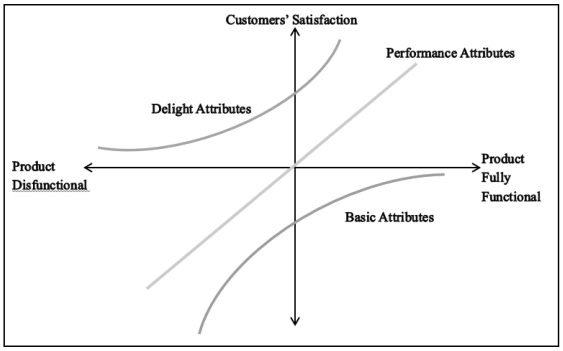
2.4.2 TMAP



2.4.3 QFD

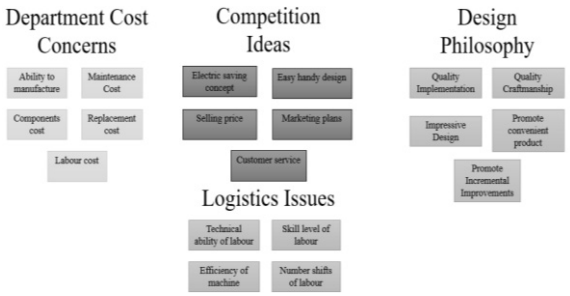


2.4.4 Kano Model

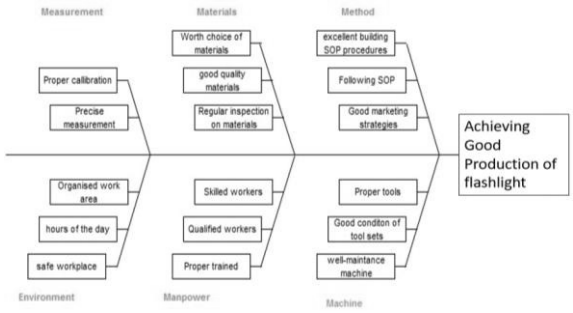


Type	Customer Requirements
Must Be (Basic Attributes)	• For light sources • Low in mass
One-Dimensional (Performance Attributes)	• Tactical string made the flashlight easier to carry • It uses dry cells
Delighters (Delight Attributes)	• Have zoom focus light • Harder body part of the torchlight can prevent the torchlight from breaking

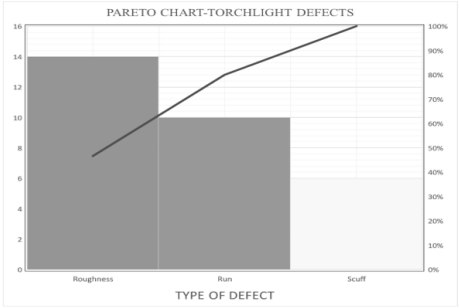
2.4.5 Affinity Diagram



2.4.6 Fishbone Diagram



2.4.7 Pareto Chart



Defect type	Roughness	Run	Scuff
Frequency	14	10	6
Cumulative Frequency	14	24	30

2.4.8 NGT

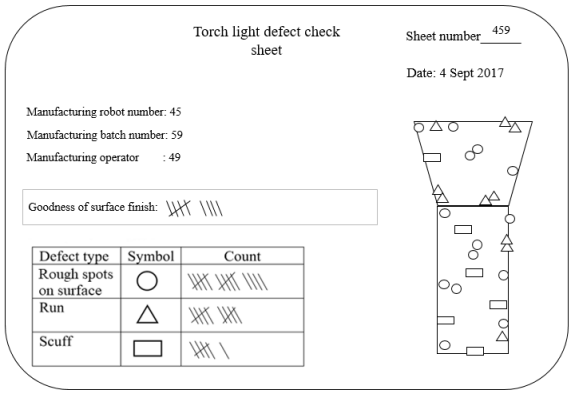
	SIZE	PRICE	QUALITY	BATTERY TYPE
Wooi Yan	3	3	4	5
Pei Fang	2	4	3	5
Hui Xin	5	1	2	3
Hamid	4	5	1	2
Czarul	3	4	5	4
Siti	3	2	3	4
Yin Yee	4	3	5	4
Mia	2	1	2	1
TOTAL	26	24	26	28

* 1 – fully disagree 5 – fully agree

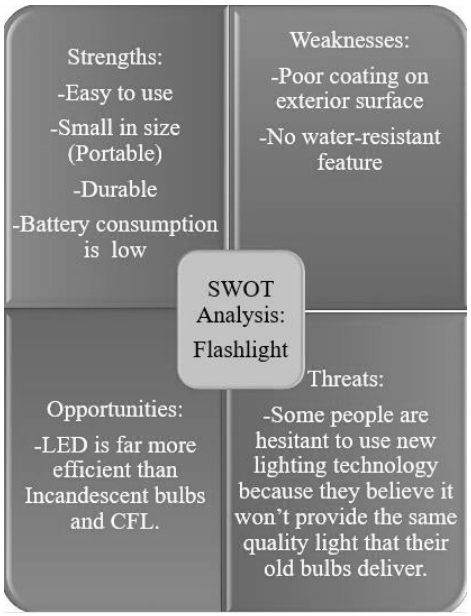
2.4.9 Delphi Technique

Aspects for flashlight	Material	Product Cost	Size of product
Duration	2 weeks	3 weeks	1 week
Number of experts selected	35	35	30
Number of experts responded	25	20	30
Findings	Material of tactical string is too fragile.	Allocated factory overhead should be minimized	The size should be minimized more for easier storage

2.4.10 Check Sheet

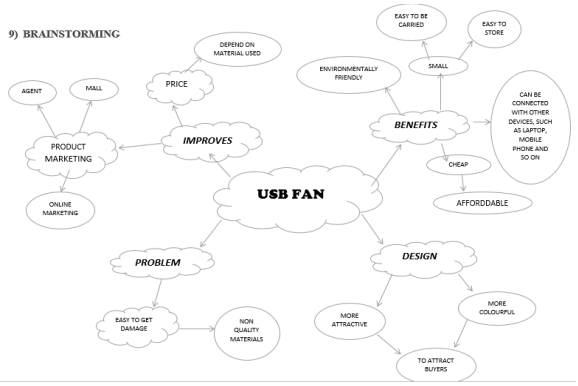


2.4.11 SWOT Analysis

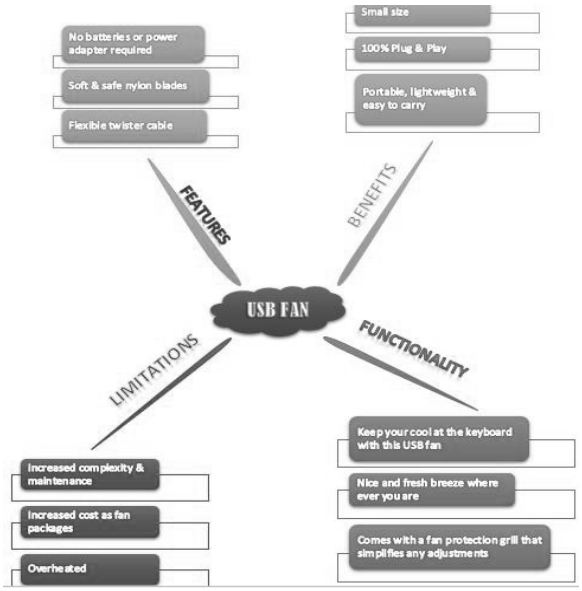


2.5 USB Fan

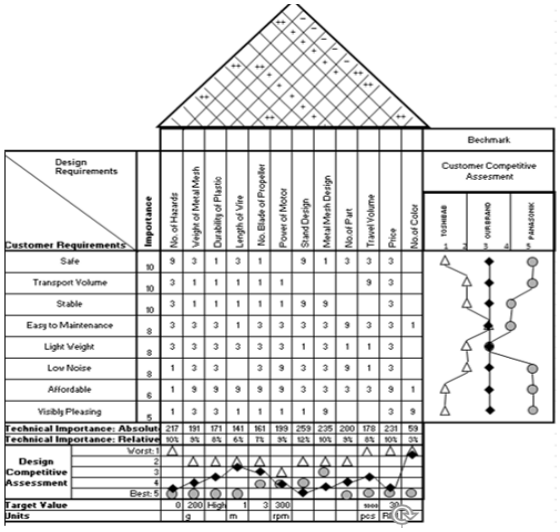
2.5.1 Brainstorming



2.5.2 TMAP



2.5.3 QFD



2.5.4 Kano Model

Helps developer to understand and follow up with the customer's requirement by categorizing product functionality into categories. There would mainly be 3 sections:

1) Exciter
Feature that storm customer by surprise, positives features that customer never thought it would be implemented as part of the product.

2) Performance
Feature that gets better rating as the quality improves. Quality and the product performance is directly proportional.

- A more solid USB fan's body that doesn't gets destroyed easily / made with metal body instead of plastics.
- Sturdier fan blade.
- Longer battery life.

3) Must have
Feature that CANNOT be miss out from the product, if the feature does not present the product will not function properly

- USB fan that doesn't have fan blade.
- battery compartment that couldn't fit the battery inside.
- faulty USB cable that doesn't fit inside computer.

2.5.5 Affinity diagram

Not making product reliable

- Customers dissatisfaction.
- Easily broken.
- Not worth the money.
- Lack of features.
- Never long-lasting.

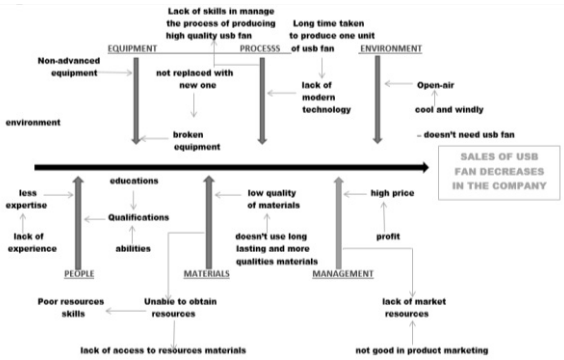
Quality of the product doesn't satisfy the workers

- Made by cheap stuffs.
- Other companies doing it better and more durable.
- The brand is not well known.

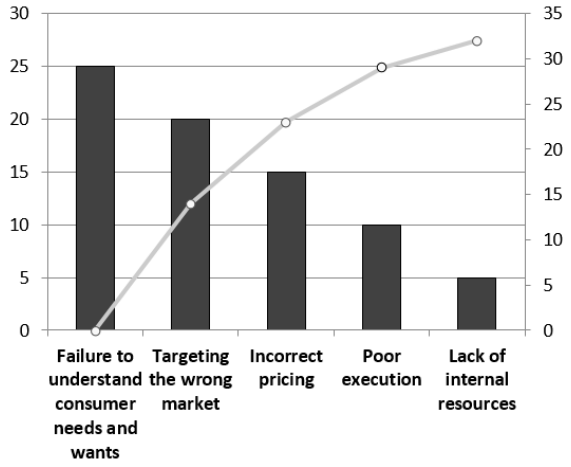
Profit of the product

- The product is no longer prefer by the customers.
- A lot of competitors in this business.
- The product is very cheap.
- The pay doesn't worth the effort.

2.5.6 Fishbone Diagram



2.5.7 Pareto Chart



2.5.8 NGT

1) Leader propose a problem/discussion "How to efficiently lower the cost / increase quality of USB fan?"
2) A small piece of paper is given out to each members to write down their opinions.
3) This way all members are given the equal opportunity to state/ point out the ways or misdoing of the operations.
4) Members wouldn't feel pressured to present their ideas in front of everyone as their ideas might not complete or offend other members.
5) Through this transparent method, group members able to find out the root cause of the problem and also solve it while avoiding argument, conflicts.

2.5.9 Delphi Technique

Evaluate based on the experts (Quality controller)

Research Area	Rate	Comments
Design	0 1 2 3 (4) 5	The design is fantastic
Convenient	0 1 2 3 4 (5)	It is very convenient for everyone as it is small and easy to bring
Price	0 1 2 3 (4) 5	The price is affordable for everyone in the market
Cost	0 1 2 (3) 4 5	The cost of production is in the normal range

Evaluate based on the experts (Designer)

Research Area	Rate	Comments
Design	0 1 2 (3) 4 5	The design is normal as compare with other USB fan product.
Convenient	0 1 2 3 4 (5)	Convenient as it is small and easy to keep inside the beg
Price	0 1 2 3 (4) 5	The price is affordable
Cost	0 1 2 3 (4) 5	The cost of production is very low

2.5.10 Check Sheet

Defect Type	Count (Per 100)	Score
Well Function	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸	35
Non-Function	𝍸	5
Technical Problem (Broken Plastic, Not in Good Condition)	𝍸 𝍸	10
Total	50	50

2.5.11 SWOT Analysis

STRENGTH
- ❖ It's a portable device, so that we can be able to bring it everywhere.
- ❖ Cheap in term of price tag.
- ❖ Don't need any electricity to function it, just a plugin to USB ports of any laptop or PC will do.
- ❖ Cool down as the weather starts to warm up.

WEAKNESS
- ❖ Not durable.
- ❖ Additional energy losses and noise when fan motors are operated in higher loads.
- ❖ Slow business.

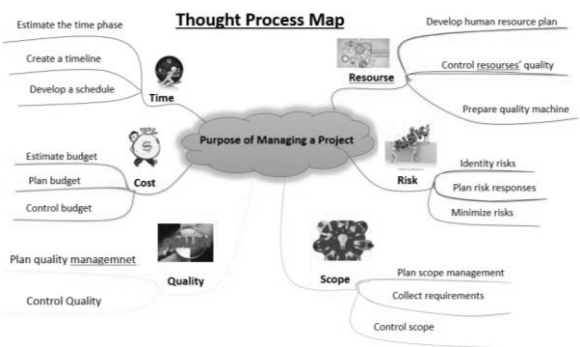
OPPORTUNITY
- ❖ The quality can be enhanced.
- ❖ Can be upgraded into 2 in 1 device.
- ❖ We can make it more affordable for customers.

THREATS
- ❖ Many competitors in making this type product.
- ❖ Not many customers prefer in using it.

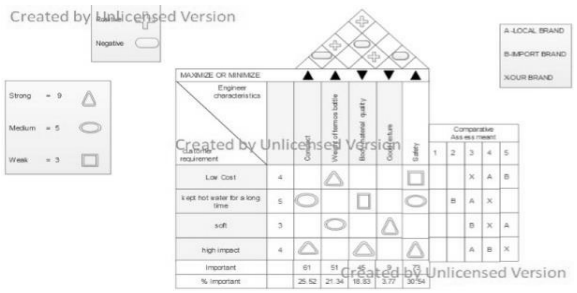
2.6 Thermos Flask

2.6.1 Brainstorming

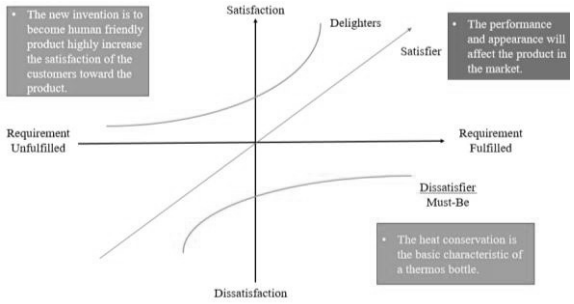
2.6.2 TMAP



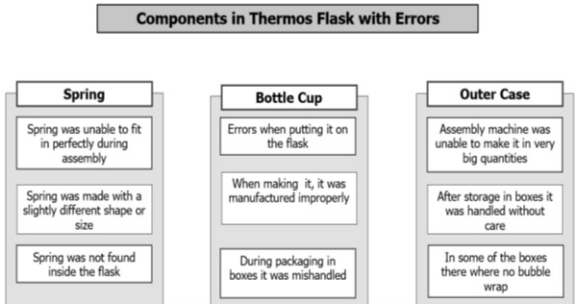
2.6.3 QFD



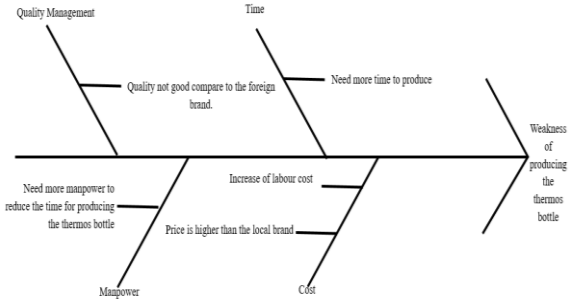
2.6.4 Kano Model



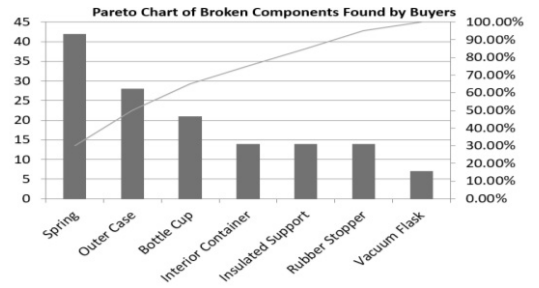
2.6.5 Affinity Diagram



2.6.6 Fishbone Diagram



2.6.7 Pareto Chart



2.6.8 NGT

Opinion / Member	Increase the Quality	Reduce Time to Process	Increase Production	Decrease the Cost
Yong	4	1	2	3
Chen	3	2	1	4
Ting	4	3	2	1
Ashraf	3	2	4	1
Norman	2	4	1	3
Total	16	12	10	12

2.6.9 Delphi Technique

Evaluated by the expert. (Designer)

Selection Factors	Level of the satisfication	Comment
1. Quality	0 1 2 (3) 4 5	The quality of the thermos bottle is normal.
2. Design	0 1 2 3 4 (5)	The design of the thermos bottle is outstanding and very fashionable.
3. Cost	0 1 2 (3) 4 5	The cost of the thermos bottle will increased due to the outstanding design.
4. Price	0 1 2 (3) 4 5	The price of the thermos will also increase because of the increased of the cost.
5. Convenient	0 1 (2) 3 4 5	This thermos bottle will only suitable to the teenage of the fashionable people.

Level of satisfication
0- Don't know
1- Bad
2- No satisfied
3- Acceptable
4- Good
5- Excellent

2.6.10 Check Sheet

Date: 12th September 2017
Product Batch No: 002
Product Serial No: TB003
Audit By: Group 6

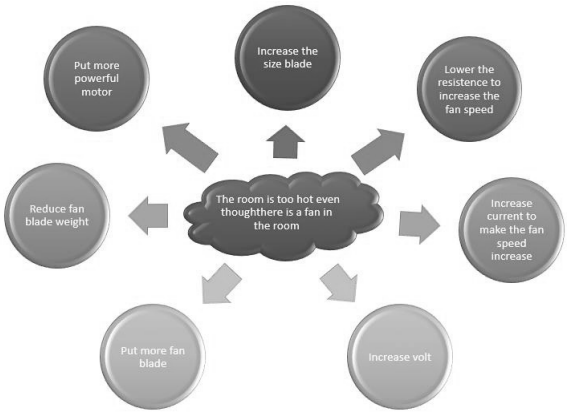
No	CHECK POINT	GOOD	BAD
1	Cap	√	
2	Stopper	√	
3	Vacuum flask	√	
4	Outer case	√	
5	Insulated support	√	

2.6.11 SWOT Analysis

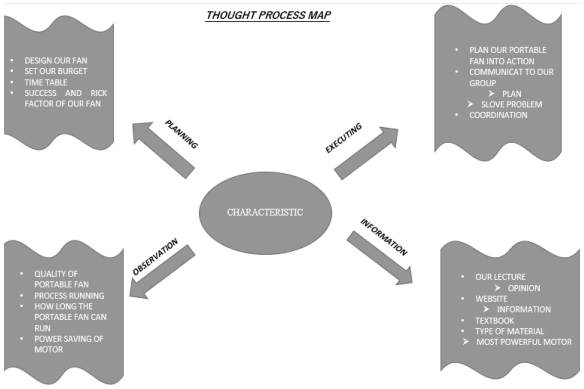
SWOT	Helpful	Harmful
Internal	Strength ➢ Our brands can keep warm for few hours. ➢ Its quality is good compare to the local brand.	Weakness ➢ Our brands need more time to produce so the labour cost is increased. ➢ Quality still not good compare to foreign brand.
External	Opportunities ➢ The market for thermos bottle growing demand. ➢ There is a new market of thermos bottle especially in coffee shop.	Threats ➢ The market of the thermos bottle is growing and causes a lot of new brand appears in the market.

2.7 Portable Fan

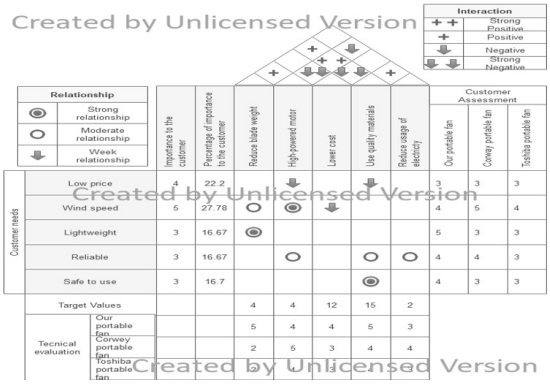
2.7.1 Brainstorming



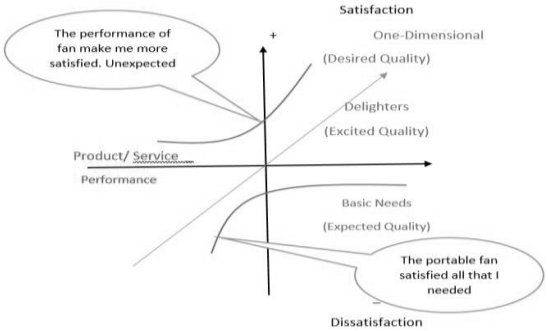
2.7.2 TMAP



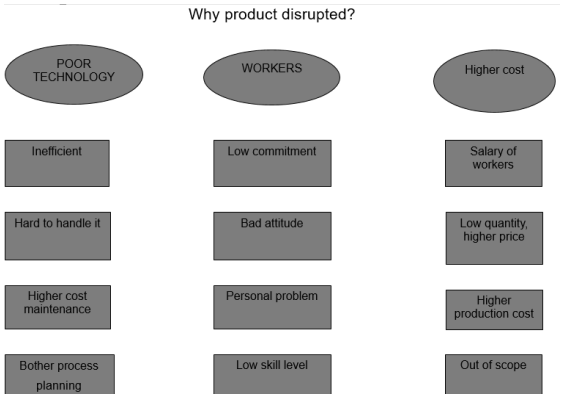
2.7.3 QFD



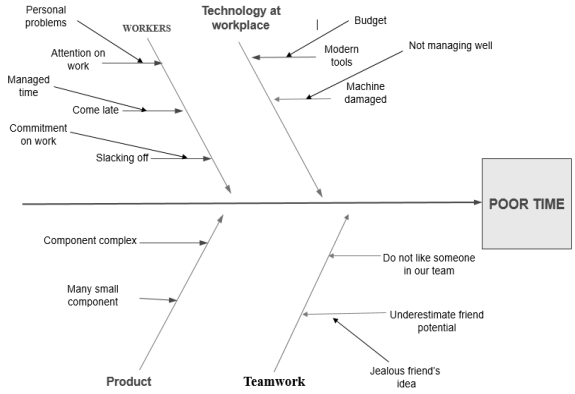
2.7.4 Kano Model



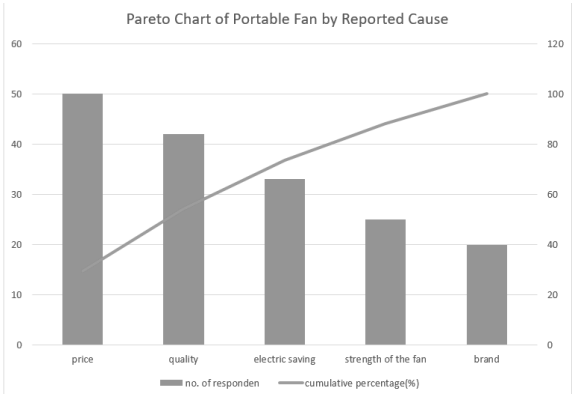
2.7.5 Affinity Diagram



2.7.6 Fishbone Diagram



2.7.7 Pareto Chart



2.7.8 NGT

Product: Portable fan Date: 19/9/2017

	Modify Shape of Portable Fan	Checking People Desire	Add another Power Sources
Nabil	3	3	2
Farhan	3	4	4
Asraf	4	2	3
Wee Sheng	2	3	4
Shamsu	3	2	3
Nain	4	3	2
Totals	**19**	**17**	**18**

(Bad) 1 2 3 4 5 (Good)

2.7.9 Delphi Technique

Product: Portable Fan Date: 19/9/2017

Unit of Measure: Characteristic

Estimator: 3 Panel

Characteristic	Panel 1 (CEO)	Panel 2 (Head of Designer)	Panel 3 (Selected Customer)
Cost	2	3	2
Function	3	4	1
Quality	2	5	4

(Poor) 1 2 3 4 5 (Good)

2.7.10 Check Sheet

Product: Portable Fan — Date: 19/9/2017

Stage: 1 — Operator: Head of Engineer

Number inspected: 15

PROBLEM BY CATEGORY	COUNT	TOTAL
Heat Damage to Component	\\\\	4
Over soldered	\\	2
Design Error in Circuit	\\	2
Not Soldered	\\\	3
Incorrect Placement	\\\\	4

2.7.11 SWOT Analysis

Strenght

- Easy to carry
- It size not to big
- Low price
- The price of the used material is not expensive
- Safe to use
- The material used will not bring injury
- Saving electricity
- This product uses a small amount of energy
- Easy to use
- This product is designed user-friendly because its use is very easy

Weaknesses

- Need to be charged before use
- Its energy will be exhausted when it is used frequently
- Easy to break
- The materials used are not high quality
- The wind not strong
- The motor used is not very strong

Opportunity

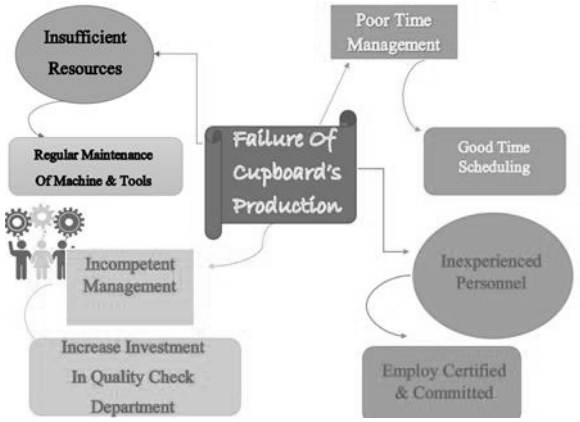
- Creates a new market
- Can open markets across the country
- Creates a new product
- Can produce better new products
- User privileges
- In hot weather, many people want to cool their bodies to relieve heat

Threats

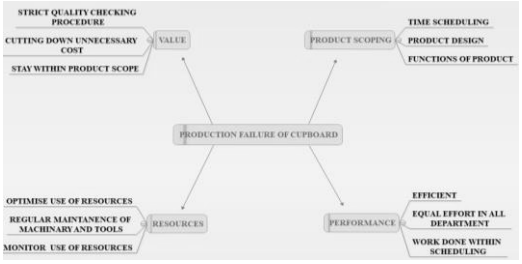
- Lost trust
- Because the material used is not high quality and easily damaged
- Facing strong competitions
- There will be a new product better than our product

2.8 Cupboard

2.8.1 Brainstorming



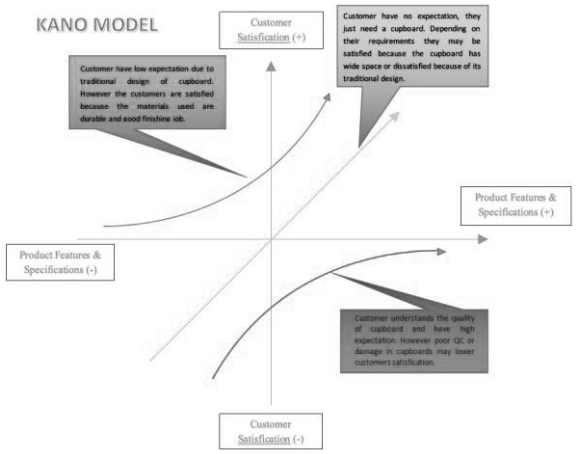
2.8.2 TMAP



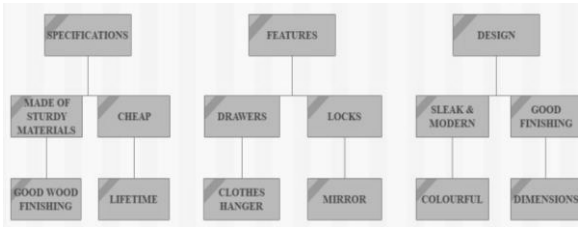
2.8.3 QFD

		Customer Importance	Weight	Width	Lifetime	Height	Breadth	Customer Importance %	IKER	NOLSIE	OURS
	Priorities		⇧	⇩	⇧	⇧	⇩				
	◉ 9- point ○ 3- point △ 1- point										
Specifications	Solid Materials	5	◉		◉			25	4	5	4
	Cheap	5	○	△	○	○	○	25	3	1	5
Features	Wide Space	3	△	◉		◉	○	15	4	4	3.5
	Modern Design	3	△	○		○	◉	15	3	4.5	2.5
	More Drawers	4	○	◉		○	○	20	1	3.5	3
	Target		55 kg	900 mm	2 years	2000 mm	600 mm				
	Importance Rating		390	385	300	315	315				
	Weight %		22.8	22.6	17.6	18.5	18.5				

2.8.4 Kano Model



2.8.5 Affinity Diagram



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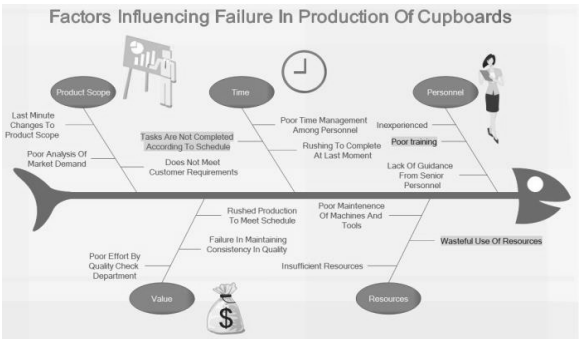
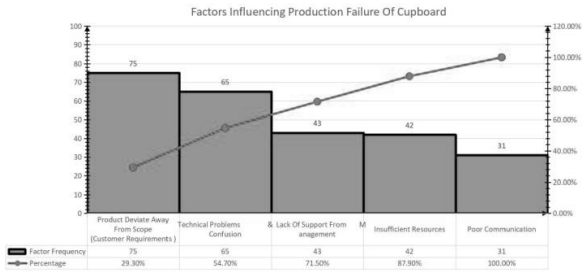


2.8.7 Pareto Chart



2.8.8 NGT

The Solution For Cupboard Production Failure

	Stricter Maintenence Of Machine And Tools	Increase Investment In Quality Checking Department	Employ Certified And More Committed Personnel
Ali	4	5	3
Muthu	4	5	4
Lim	5	4	2
Siti	4	3	5
Charlie	5	4	3
Totals	22	21	17

2.8.9 Delphi Technique

How To Increase Value Of Cupboard In Market.

	Increase Investment In Quality Checking Department	Comments	2nd Round Comments Edited
MANUFACTURING ENGINEER	2	Management should be more particular about time management and scheduling of the project compared to QC	Management should pay more attention to the quality aspect of product as customers are more impressed in deign and quality.
INTERIOR DESIGNER	5	There has to be stricter emphasis on design aspect of the product such as (Finishing, Design Details, Cracks etc.)	"No Changes In Opinion"
MARKET ANALYST	4	Design is a major factor that contributes to the value of the cupboard. A good design is what catches the eye of the customer	" No Changes In Opinion"

2.8.10 Check Sheet

Cupboard Door Patent Check Sheet

Sheet Number : 001

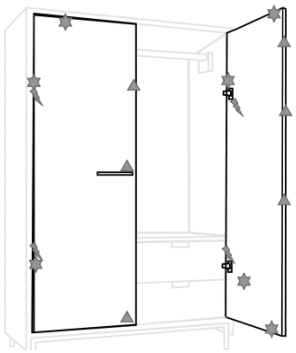
Machine Number : X0001 Date : 15th Oct

Batch Number : A0001

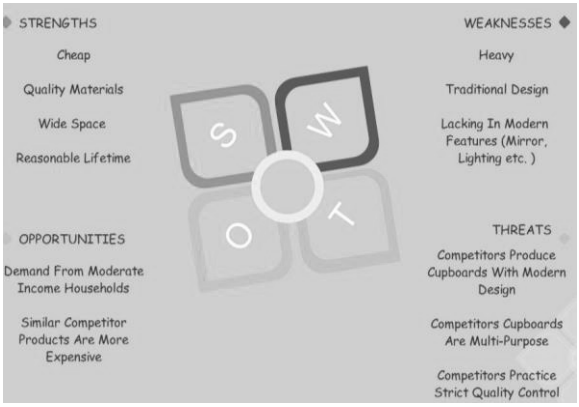
Operator : Syafii

Door Produce : 10

Defect type	Symbol	Count
Crack		7
Rotten Woodwork		6
Broken Cupboard		4



2.8.11 SWOT Analysis



CHAPTER 3

PROJECT INITIATION

Outcome based Education:

1. Students are able to develop a project charter.
2. Students are able to decide a good potential project based on net present value (NPV), payback period (PP) and internal rate of return (IRR).

3.1 Reversible Umbrella

3.1.1 Project Charter

Objectives:

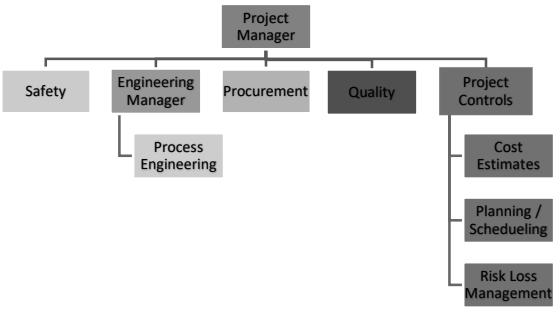
1. To help prevent water leakage from happening in our home or public place.
   Explanation: It is because the umbrella collects water when it closed so we can easily dispose of it in neat.
2. To make it easier to closed the umbrella when entering the vehicle.
   Explanation: It is because it can prevent any rain spillage in vehicle especially when the user closed the umbrella.
3. To improve the design of the classic umbrella.
   Explanation: Prevent the strong wind from pushing the umbrella upside down.
4. To improve the durability of the umbrella.
   Explanation: Improve the lifetime of umbrella from breaking.

Scope:

1. Target customer: Public
2. Price to be sold: RM35
3. Material: Rubber, Alloy, Nylon
4. Process concern: Manufacturing process

The process begins with accurately cutting fabric for the umbrella panels, using chalk and a circular saw, into tessellated triangles. Frames are then constructed. A push button is added to the sliding mechanism and the central pole pushed through, with the two sections neatly nailed together to complete the frame. Canopies are stitched in a variety of panel colors, with the tips of the umbrella sewn on and a topping ring added. Completed frames are then sewn to the canopy and the frame tips are attached. After thorough inspection, the umbrellas are packed and shipped to the customer.

3.1.2 Development Project Team



3.1.3 Comparison of Proposed Project

1. Multi-function
2. Colorful
3. Compact sized
4. Hazard Lamp

	Very poor	Poor	Fair	Average	Good	Excellent	
	0	1	2	3	4	5	
Low				Attractiveness			High
High				Cost			Low
Hard				Comfortability			Easy
Long				Time			Short

A – Attractiveness
B – Cost
C – Comfortability
D – Time

No	Alternative project	A	B	C	D	Total Score
1	Multi - function	4	3	4	4	17
2	Colourful	1	2	3	3	9
3	Compact sized	3	4	2	2	11
4	Hazard lamp	2	1	1	1	5

Results of Screening
Project 1# Multi-function
Project 3# Compact sized

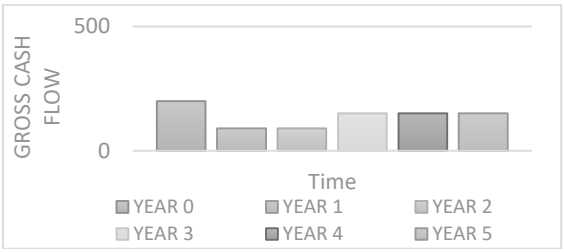
3.1.4 Project Selection

Project 1

- Initial investment (I) = RM 200,000
- Annual cost of operation = RM 10,000
- Planning horizon of 5 years
- Expected annual revenues = RM 100k for the first two years
- Expected annual revenues = RM 160,000 for the next three years

Year	0	1	2	3	4	5
Cost	-200	-10	-10	-10	-10	-10
Revenues		100	100	160	160	160

(All revenues and costs are in thousands of RM)



Undiscounted cash flows before tax						
Year	0	1	2	3	4	5
Cash Flow	-200	90	90	150	150	150
Cumulative Cash Flow	-200	-110	-20	130	280	430

- NPV = 430 (in thousands)
- PP = 2.15 years

Discounted Cash Flows for Interest Rate = 10%						
Year	0	1	2	3	4	5
Cash Flow	-200	90	90	150	150	150
Discount Factor	1	0.909	0.826	0.751	0.683	0.621
Discounted Cash Flow (DCF)	-200	81.81	74.34	112.65	102.45	93.15
Cumulative Discounted Cash Flow	-200	-118.19	-43.85	68.8	171.25	264.4

- NPV = 264.4 (in thousands)
- PP = 2.45 years

Discounted Cash Flows for Interest Rate = 20%						
Year	0	1	2	3	4	5
Cash Flow	-200	90	90	150	150	150
Discount Factor	1	0.833	0.694	0.579	0.482	0.402
Discounted Cash Flow (DCF)	-200	74.97	62.46	86.85	72.3	60.3
Cumulative Discounted Cash Flow	-200	-125.03	-62.57	24.28	96.58	156.88

- NPV = 156.88 (in thousands)
- PP = 2.72 years

Discounted Cash Flows for Interest Rate = 25%						
Year	0	1	2	3	4	5
Cash Flow	-200	90	90	150	150	150
Discount Factor	1	0.800	0.640	0.512	0.410	0.328
Discounted Cash Flow (DCF)	-200	72.00	57.60	76.80	61.50	49.20
Cumulative Discounted Cash Flow	-200	-128.00	-70.40	6.40	67.90	117.1

- NPV = 117.1 (in thousands)
- PP = 2.94 years

Discounted Cash Flows for Interest Rate = 30%						
Year	0	1	2	3	4	5
Cash Flow	-200	90	90	150	150	150
Discount Factor	1	0.769	0.592	0.445	0.350	0.269
Discounted Cash Flow (DCF)	-200	69.21	53.28	66.75	52.50	40.35
Cumulative Discounted Cash Flow	-200	-130.79	-77.51	-10.76	41.74	82.09

- NPV = 82.09 (in thousands)
- PP = 3.23 years

Discounted Cash Flows for Interest Rate = 35%						
Year	0	1	2	3	4	5
Cash Flow	-200	90	90	150	150	150
Discount Factor	1	0.741	0.549	0.406	0.301	0.223
Discounted Cash Flow (DCF)	-200	66.69	49.41	60.9	45.15	33.45
Cumulative Discounted Cash Flow	-200	-133.31	-83.90	-23.00	22.15	55.60

- NPV = 55.60 (in thousands)
- PP = 3.51 years

Discounted Cash Flows for Interest Rate = 40%						
Year	0	1	2	3	4	5
Cash Flow	-200	90	90	150	150	150
Discount Factor	1	0.714	0.510	0.364	0.260	0.186
Discounted Cash Flow (DCF)	-200	64.26	45.90	54.60	39.00	27.90
Cumulative Discounted Cash Flow	-200	-135.74	-89.84	-35.24	3.76	31.66

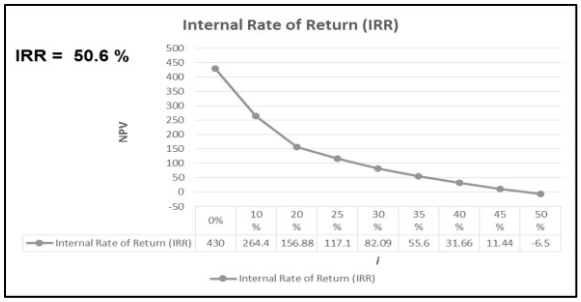
- NPV = 31.66 (in thousands)
- PP = 3.90 years

Discounted Cash Flows for Interest Rate = 45%						
Year	0	1	2	3	4	5
Cash Flow	-200	90	90	150	150	150
Discount Factor	1	0.690	0.476	0.328	0.226	0.156
Discounted Cash Flow (DCF)	-200	62.1	42.84	49.20	33.90	23.4
Cumulative Discounted Cash Flow	-200	-137.9	-95.06	-45.86	-11.96	11.44

- NVP = 11.44
- PP = 4.51 years

Discounted Cash Flows for Interest Rate = 50%						
Year	0	1	2	3	4	5
Cash Flow	-200	90	90	150	150	150
Discount Factor	1	0.666	0.444	0.296	0.197	0.131
Discounted Cash Flow (DCF)	-200	59.94	39.96	44.40	29.55	19.65
Cumulative Discounted Cash Flow	-200	-140.06	-100.1	-55.7	-26.15	-6.50

- NVP = -6.50
- PP = > 5 years



Computation of After Tax Cash Flows					
Year	1	2	3	4	5
Cash Flow	90	90	150	150	150
Depreciation	40	40	40	40	40
Taxable Income	50	50	110	110	110
Tax (30%)	15	15	33	33	33
After Tax Cash Flow	75	75	117	117	117

Undiscounted After Tax Cash Flows						
Year	0	1	2	3	4	5
After Tax Cash Flow	-200	75	75	117	117	117
Cumulative Cash Flow	-200	-125	-50	67	184	301

- NVP = 301 (in thousands)
- PP = 2.42 years

After Tax Discounted Cash Flows for interest Rate = 20%						
Year	0	1	2	3	4	5
After Tax Cash Flow	-200	75	75	117	117	117
Discount Factor	1	0.833	0.694	0.579	0.482	0.402
Discounted Cash Flow (DCF)	-200	62.47	52.05	67.74	56.39	47.03
Cumulative Discounted Cash Flow	-200	-137.53	-85.48	-17.74	38.65	85.68

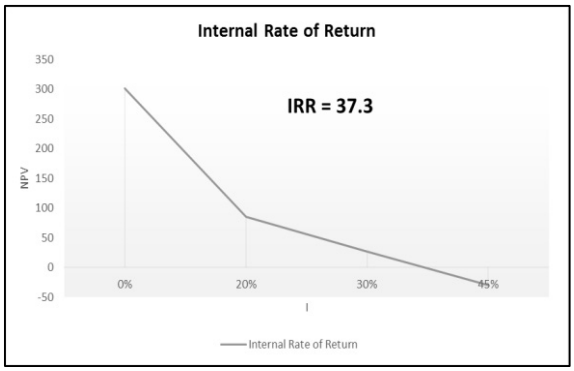
- NPV = 85.68 (in thousands)
- PP = 3.31 Years

After Tax Discounted Cash Flows for Interest Rate = 30%						
Year	0	1	2	3	4	5
After Tax Cash Flow	-200	75	75	117	117	117
Discount Factor	1	0.769	0.592	0.445	0.350	0.269
Discounted Cash Flow (DCF)	-200	57.67	44.4	52.06	40.95	31.47
Cumulative Discounted Cash Flow	-200	-142.33	-97.93	-45.87	-4.92	26.55

- NPV = 26.55 (in thousands)
- PP = 4.15 years

After Tax Discounted Cash Flows for Interest Rate = 45%						
Year	0	1	2	3	4	5
After Tax Cash Flow	-200	75	75	117	117	117
Discount Factor	1	0.690	0.476	0.328	0.226	0.156
Discounted Cash Flow (DCF)	-200	51.75	35.70	38.37	26.44	18.25
Cumulative Discounted Cash Flow	-200	-148.25	-112.55	-74.18	-47.74	-29.49

- NPV = -29.49 (in thousands)
- PP = >5 years

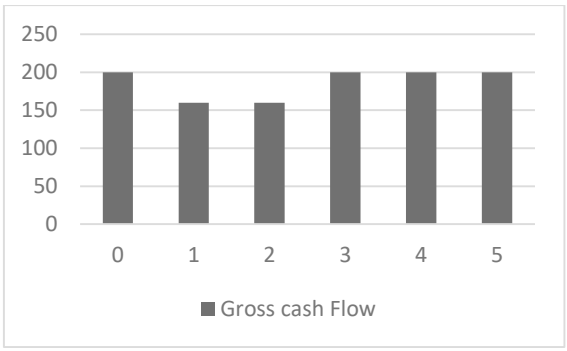


Project 2

- Planning horizon for next 5 year
- Expected annual revenues for the first 2 years = RM 160,000
- Expected annual revenues for the next 3 years = RM 200,000

Year	1	2	3	4	5
Costs	-200	-40	-40	-40	-40
Revenues	160	160	200	200	200

(*All revenues and costs are in thousands of RM*)

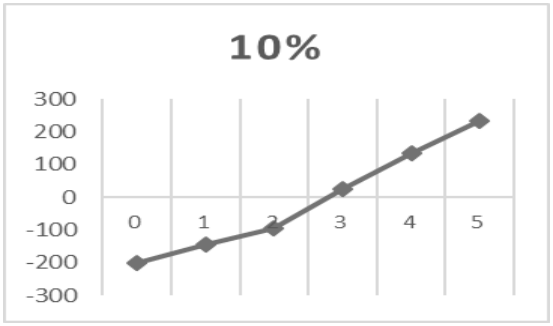


Undiscounted Cash Flows Before Tax

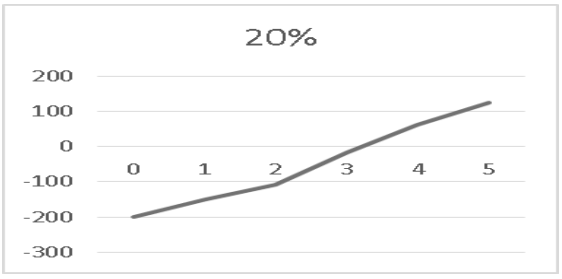
Year	0	1	2	3	4	5
Cash Flow	-200	54	54	124	124	124
Cumulative Cash Flow	-200	-146	-92	32	156	280

- NPV = 280(in thousand)
- PP = 3.7 years

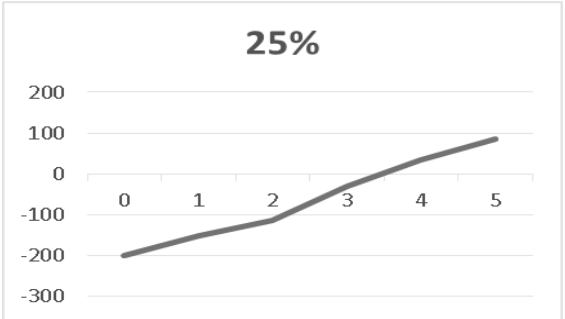
Discount Cashflow for interest rate 10%						
Year	0	1	2	3	4	5
Cash Flow(RM)	-200	60	60	160	160	160
Discount Factor	1	0.909	0.826	0.751	0.683	0.621
DCF	-200	54.54	49.56	120.16	109.28	99.36
Cumulative	-200	-145.46	-95.9	24.26	133.54	232.9
Net present value(NVP)= 232.9						
Payback Period= 2.8						



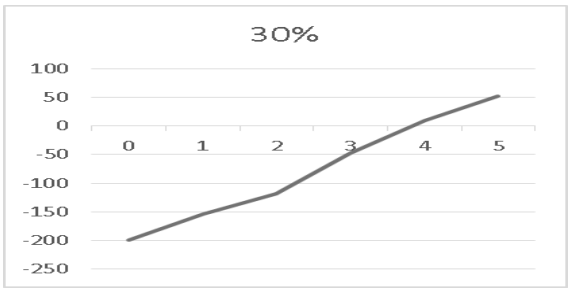
Discount Cashflow for interest rate 20%						
Year	0	1	2	3	4	5
Cash flow(RM)	-200	60	60	160	160	160
Discount factor	1	0.833	0.694	0.579	0.482	0.402
DCF	-200	49.98	41.64	92.64	77.12	64.32
Cumulative	-200	-150.02	-108.38	-15.74	61.38	125.7
Net present value(NVP)= 125.7						
Payback Period= 3.3						



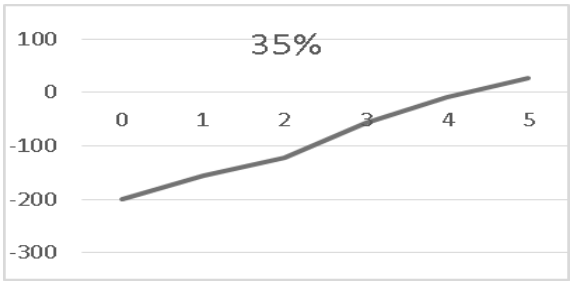
Discount Cashflow for interest rate 25%						
Year	0	1	2	3	4	5
Cash Flow(RM)	-200	60	60	160	160	160
Discount Flow	1	0.8	0.64	0.512	0.41	0.328
DCF	-200	48	38.4	81.92	65.6	52.48
Cumulative	-200	-152	-113.6	-31.68	33.92	86.32
Net present value(NVP)= 86.32						
Payback Period= 3.5						



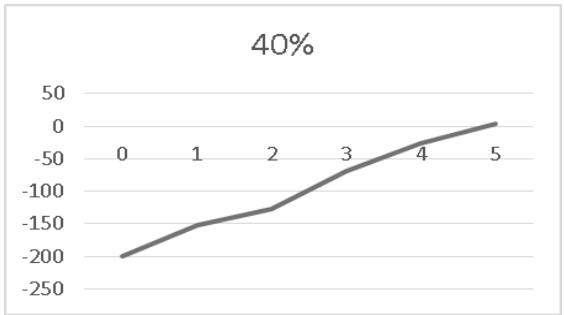
Discount Cashflow for interest rate 30%						
Year	0	1	2	3	4	5
Cash Flow(RM)	-200	60	60	160	160	160
Discount Flow	1	0.769	0.592	0.445	0.35	0.269
DCF	-200	46.14	35.52	71.2	56	43.04
Cumulative	-200	-153.86	-118.34	-47.14	8.86	51.9
Net present value(NVP)= 51.9						
Payback Period= 3.86						



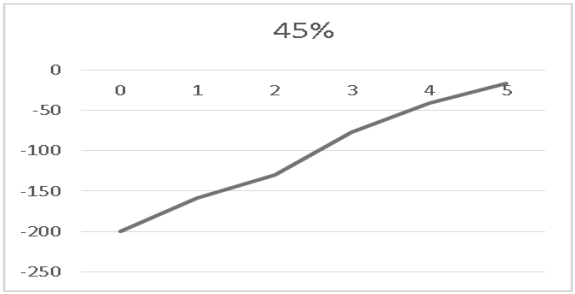
Discount Cashflow for interest rate 35%						
Year	0	1	2	3	4	5
Cash Flow(RM)	-200	60	60	160	160	160
Discount Flow	1	0.741	0.549	0.406	0.301	0.223
DCF	-200	44.46	32.94	64.96	48.16	35.68
Cumulative	-200	-155.54	-122.6	-57.69	-9.48	26.2
Net present value(NVP)= 26.2						
Payback Period= 4.2						



Discount Cashflow for interest rate 40%						
Year	0	1	2	3	4	5
Cash Flow(RM)	-200	60	60	160	160	160
Discount Flow	1	0.714	0.51	0.364	0.26	0.186
DCF	-200	42.84	30.6	58.24	41.6	29.76
Cumulative	-200	-152.16	-126.56	-68.32	-26.72	3.04
Net Present Value(NVP)= 3.04						
Payback Period= 4.9						



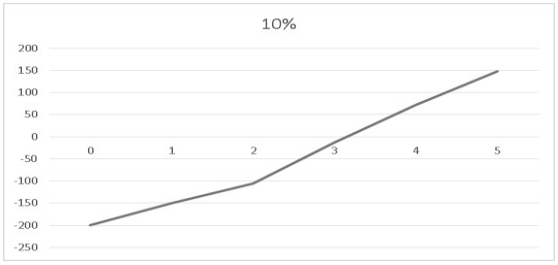
Discount Cashflow for interest rate 45%						
Year	0	1	2	3	4	5
Cash Flow(RM)	-200	60	60	160	160	160
Discount Flow	1	0.69	0.476	0.328	0.226	0.156
DCF	-200	41.4	28.56	52.48	36.16	24.96
Cumulative	-200	-158.6	-130.04	-77.56	-41.4	-16.44
Net Present Value(NVP)= -16.44						
Payback Period= >5years						



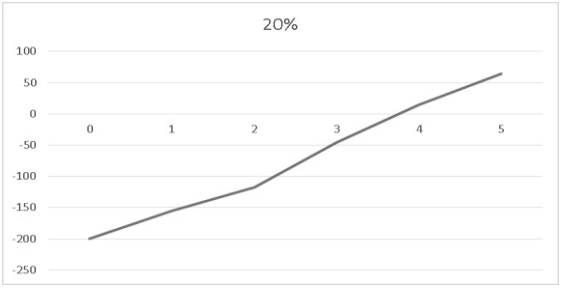
Discount After Tax for interest rate 10%						
Year	0	1	2	3	4	5
Cash Flow(RM)	-200	54	54	124	124	124
Discount Factor	1	0.909	0.826	0.751	0.683	0.621
DCF	-200	49.09	44.6	93.12	84.69	77
Cumulative	-200	-150.91	-106.31	-13.19	71.5	148.5
Net present value(NVP)= 148.5						
Payback Period= 3.3						

Computation of After Tax Cash Flow

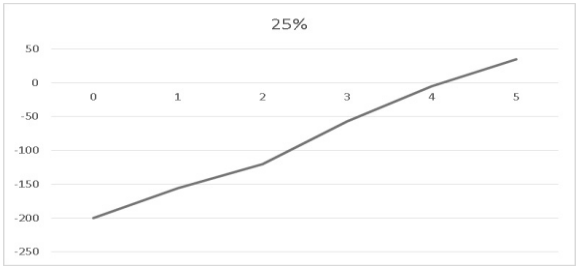
Year		1	2	3	4	5
Cash Flow	A	60	60	160	160	160
Depreciation	B	40	40	40	40	40
Taxable Income	C	20	20	120	120	120
Tax (30%)	D	6	6	36	36	36
After Tax Cash Flow	E	54	54	124	124	124



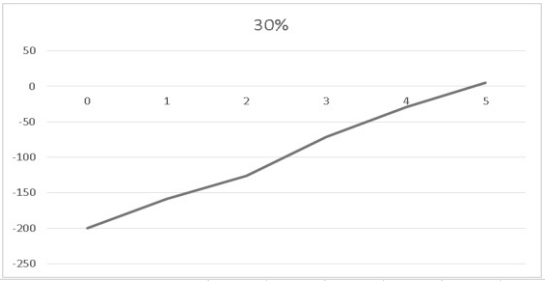
Discount After Tax for interest rate 20%						
Year	0	1	2	3	4	5
Cash flow(RM)	-200	54	54	124	124	124
Discount factor	1	0.803	0.694	0.579	0.482	0.402
DCF	-200	44.98	37.48	71.8	59.77	49.85
Cumulative	-200	-155.02	-117.54	-45.79	14.03	63.88
Net present value(NVP)= 63.88						
Payback Period= 3.7						



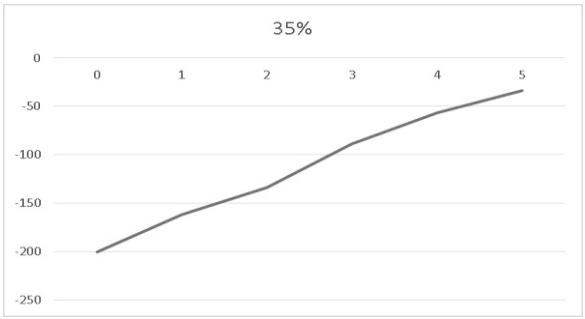
Discount After Tax for interest rate 25%						
Year	0	1	2	3	4	5
Cash Flow(RM)	-200	54	54	124	124	124
Discount Flow	1	0.8	0.64	0.512	0.41	0.328
DCF	-200	45.36	34.56	63.49	50.84	40.67
Cumulative	-200	-155.69	-120.08	-56.59	-5.25	34.92
Net present value(NVP)= 34.92						
Payback Period= 4.2						

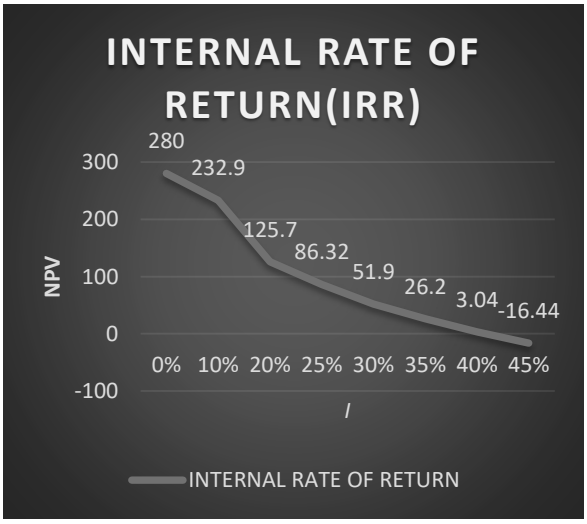


Discount After Tax for interest rate 30%						
Year	0	1	2	3	4	5
Cash Flow(RM)	-200	54	54	124	124	124
Discount Flow	1	0.769	0.592	0.445	0.35	0.269
DCF	-200	41.53	31.97	55.18	43.4	33.36
Cumulative	-200	-158.47	-126.5	-71.32	-28.92	5.44
Net present value(NVP)= 5.44						
Payback Period= 4.8						



Discount After Tax for interest rate 35%						
Year	0	1	2	3	4	5
Cash Flow(RM)	-200	54	54	124	124	124
Discount Flow	1	0.719	0.51	0.364	0.26	0.185
DCF	-200	38.56	27.54	45.19	32.24	22.94
Cumulative	-200	-161.44	-133.9	-88.76	-56.52	-33.58
Net Present Value(NVP)= -33.58						
Payback Period= >5 years						





IRR=42.5%

Conclusion: Based on both projects, Project 1 is accepted as it has higher Net Present Value (NPV), lower Internal Rate of Return (IRR), and shorter Payback Period (PP).

3.2 Bell-Shaped Umbrella

3.2.1 Project Charter

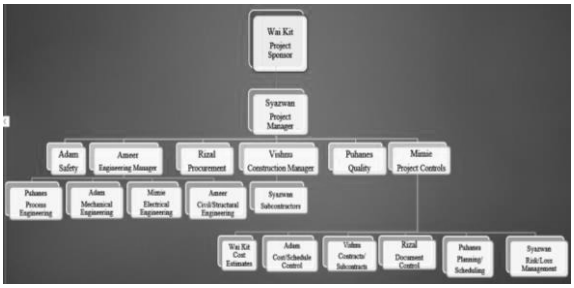
Objective:

1. Make a handle that's comfort for hold.
   It's important for user to find the umbrella that has comfort handle. Especially during windy, winter, raining and etc, because if the handle is not suitable and hard for user to hold it's can irritate the users. An objective is producing the product that's understood what the customers need and knows what the best choice to produce quality product. Avoid producing bulky and heavy handle.
2. The canopy about 10 or 11 inches more.
   A large size of canopy it is good for protection. The large size of the canopy can make user fell more safety, then comfortable to use it during raining because increase the size of canopy, can increase the protection from precipitation.
3. Vented canopy.
   The canopy is main structure of umbrella, which it is important to really know the fabric that has to use for produce the canopies. Vented umbrella is more resistance from rain, wind and it also very effective in ventilating air, then it is simplified manufacturing process.
4. Eco friendly environment umbrella.
   Why not make the eco-friendly environment umbrella by using the recycle material? Maybe it's hard to produce the umbrella as good as brelli umbrella which mostly materials of brelli umbrella is produce by bamboo but by recycle the materials it also can reduce a lots of pollution.

Scope:

1. The target customers are students and villagers.
2. The price total of product cannot be too expensive because the target is students and villagers (RM15-20).
3. Material product is handle, open/close button, shaft, runner, ribs, stretcher, stopper, cap and canopy.
4. Marketing product is focus on social media, flyers and has collaboration with megamall and etc.

3.2.2 Development Project Team



3.2.3 Comparison of Proposed Project

To manufacture an advantageous Umbrella

1. UV protection
2. Foldable
3. Light (easy carry)
4. With cover
5. Push button auto open
6. With water-proof LED
7. Comfy hand-gripped handle

	VERY POOR	POOR	AVERAGE	GOOD	EXCELLENT	
	1	2	3	4	5	
Low	Customer Fulfillment					High
High	Cost					Low
Hard	Possibility					Easy
Slow	Production Time					Fast

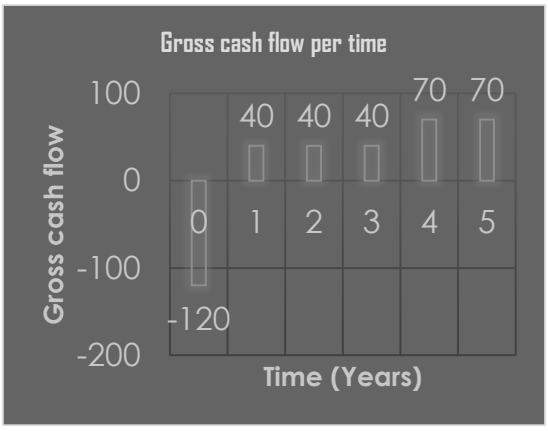
No.	Selective Projects	A	B	C	D	Total Score
1)	UV protection	4	2	2	3	11
2)	Foldable	3	2	2	3	10
3)	Light (easy carry)	4	4	4	4	12
4)	With cover	4	4	4	3	15
5)	Push button auto open	5	1	2	3	11
6)	With water-proof LED	3	1	1	1	6
7)	Comfy hand-gripped handle	4	3	4	3	14

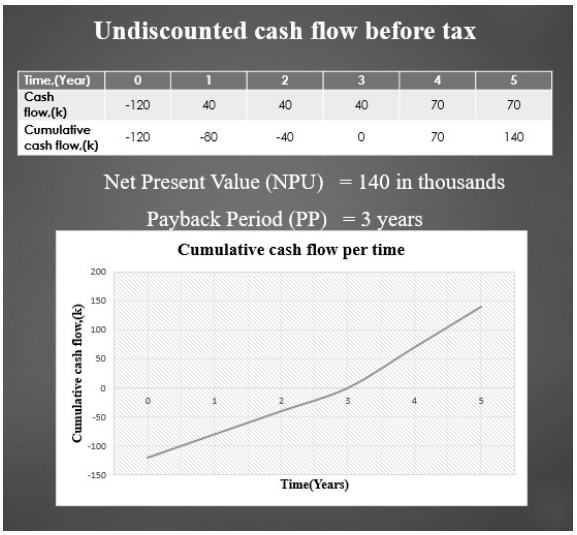
3.2.4 Project Selection

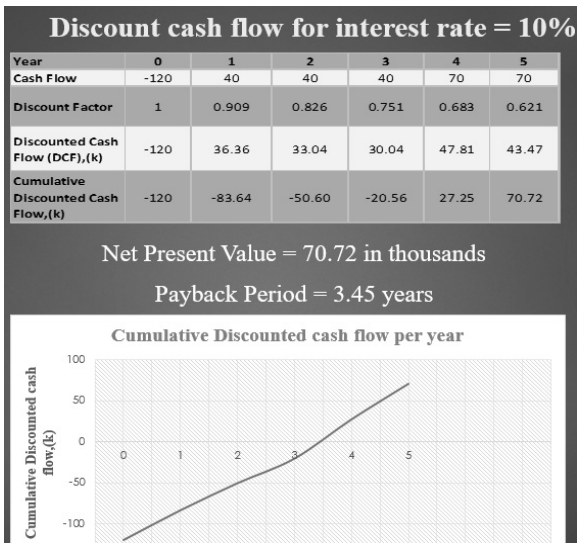
Project A

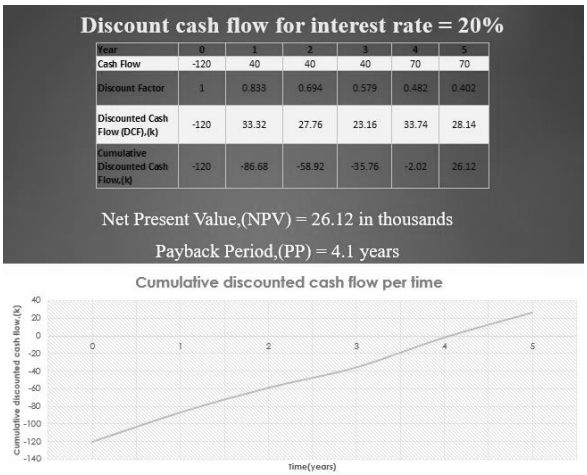
- Initial Investment = RM120,0000
- Annual Investment = RM10,000
- Planning horizon of 5 years
- Expected annual revenues is RM 50,000 for the first three years.
- Expected annual revenues is RM 80,000 for the next two years.

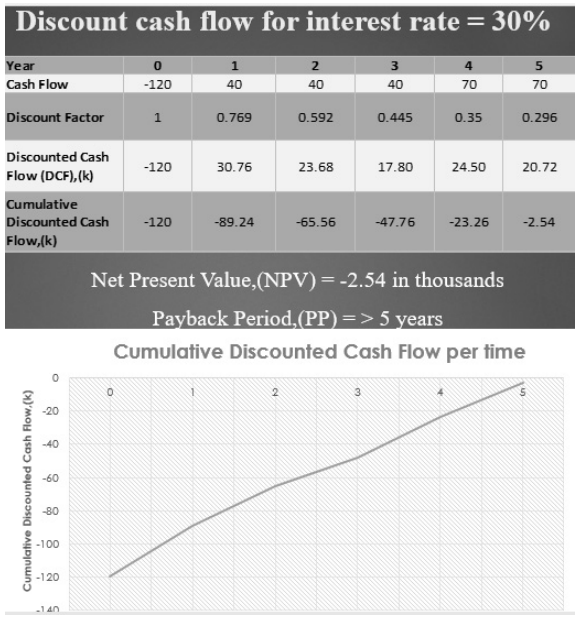
Years	**0**	**1**	**2**	**3**	**4**	**5**
Costs	-120	-10	-10	-10	-10	-10
Revenues		50	50	50	80	80



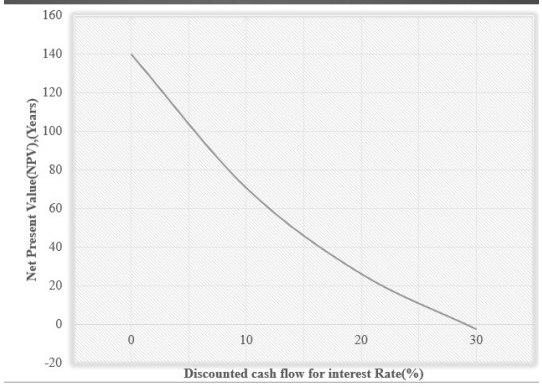


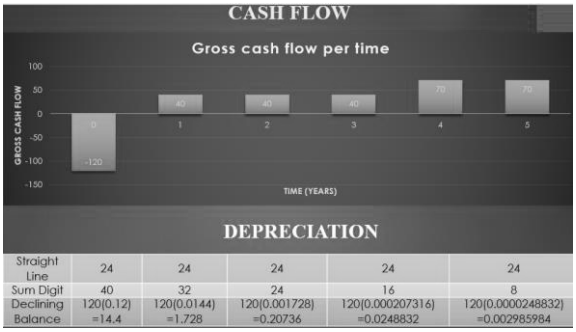






Interest rate of return = 28.5%





DEPRECIATION

Straight Line	24	24	24	24	24
Sum Digit	40	32	24	16	8
Declining Balance	120(0.12) =14.4	120(0.0144) =1.728	120(0.001728) =0.20736	120(0.000207316) =0.0248832	120(0.0000248832) =0.002985984

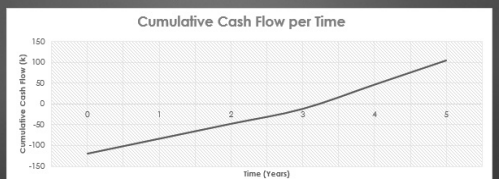
Computation of After Tax Cash Flows

Year			1	2	3	4	5
Cash Flow	a		40	40	40	70	70
Depreciation	b		24	24	24	24	24
Taxable Income	c	a-b	16	16	16	46	46
Tax (30%)	d	Tax*c	4	4	4	11.5	11.5
After Tax Cash Flow	e	a-d	36	36	36	58.5	58.5

Undiscounted After Tax Cash Flows

Year	0	1	2	3	4	5
After Tax Cash Flow	-120	36	36	36	58.5	58.5
Cumulative Cash Flow	-120	-84	-48	-12	46.5	105

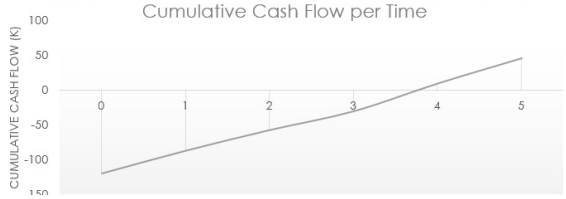
Net Present Value (NPV) = 105 in thousands
Payback Period = 3.2 years



After Tax Discounted Cash Flows for Interest Rate = 10%

Year	0	1	2	3	4	5
After Tax Cash Flow	36	36	36	36	58.5	58.5
Discount Factor	1	0.909	0.826	0.751	0.683	0.621
Discounted Cash Flow (DCF),(k)	-120	32.72	29.74	27.04	39.96	36.33
Cumulative Discounted Cash Flow,(k)	-120	-87.28	-57.54	-30.50	9.45	45.78

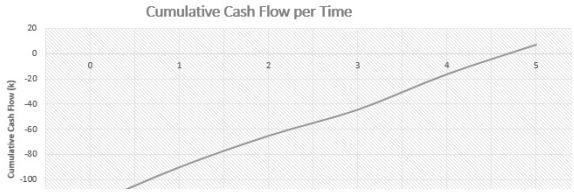
Net Present Value (NPV) = 45.78 in thousands
Payback Period = 3.7 years



After Tax Discounted Cash Flow for Interest Rate = 20%

Year	0	1	2	3	4	5
After Tax Cash Flow	36	36	36	36	58.5	58.5
Discount Factor	1	0.833	0.694	0.579	0.482	0.402
Discounted Cash Flow (DCF),(k)	-120	29.99	24.98	20.84	28.20	23.52
Cumulative Discounted Cash Flow,(k)	-120	-90.01	-65.03	-44.18	-15.99	7.53

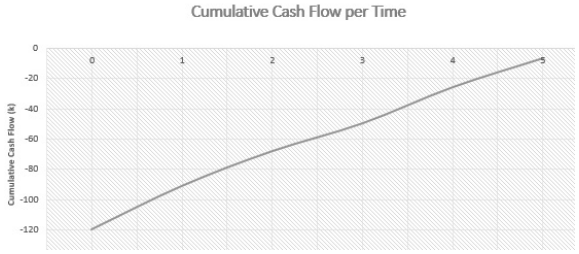
Net Present Value (NPV) = 7.53 in thousands
Payback Period = 4.7 years



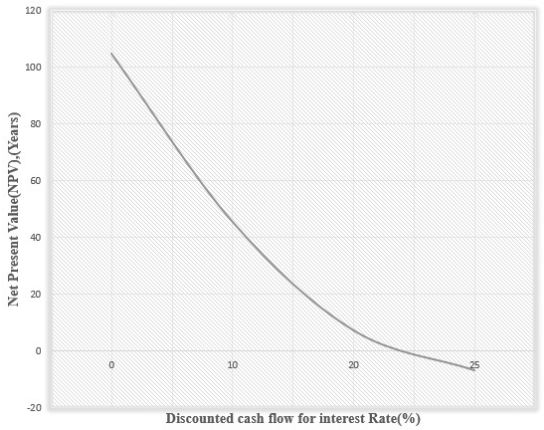
After Tax Discounted Cash Flow for Interest Rate = 25%

Year	0	1	2	3	4	5
After Tax Cash Flow	36	36	36	36	58.5	58.5
Discount Factor	1	0.8	0.64	0.512	0.41	0.328
Discounted Cash Flow (DCF),(k)	-120	28.80	23.04	18.43	23.99	19.19
Cumulative Discounted Cash Flow,(k)	-120	-91.20	-68.16	-49.73	-25.74	-6.55

Net Present Value (NPV) = -6.55 in thousands
Payback Period = >5 Years



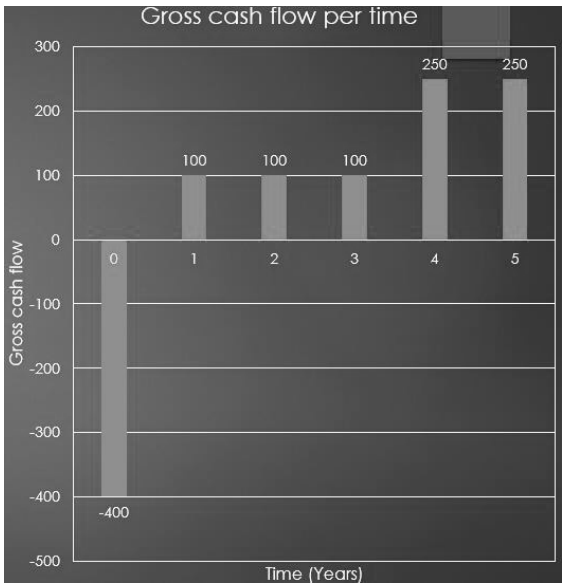
Internal Rate of Return = 22.3%



Project B

- Initial Investment = RM400,0000
- Annual Investment = RM50,000
- Planning horizon of 5 years
- Expected annual revenues is RM 150,000 for the first three years.
- Expected annual revenues is RM 300,000 for the next two years.

Years	0	1	2	3	4	5
Costs	-400	-50	-50	-50	-50	-50
Revenues		150	150	150	300	300



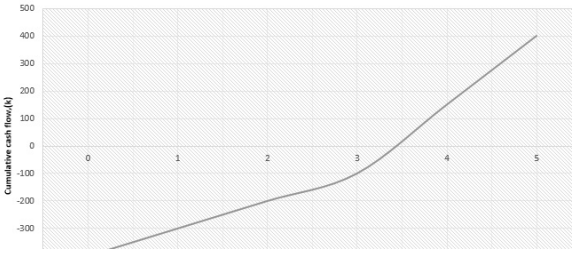
Undiscounted cash flow before tax

Time,(Year)	0	1	2	3	4	5
Cash flow,(k)	-400	100	100	100	250	250
Cumulative cash flow,(k)	-400	-300	-200	-100	150	400

Net Present Value (NPU) = 400 in thousands

Payback Period (PP) = 3.8 years

Cumulative cash flow per time



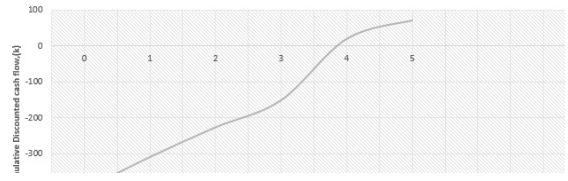
Discount cash flow for interest rate = 10%

Year	0	1	2	3	4	5
Cash Flow	-400	100	100	100	250	250
Discount Factor	1	0.909	0.826	0.751	0.683	0.621
Discounted Cash Flow (DCF),(k)	-400	90.90	82.60	75.10	170.75	155.25
Cumulative Discounted Cash Flow,(k)	-400	-309.10	-226.50	-151.40	19.35	174.60

Net Present Value = 174.60 in thousands

Payback Period = 4.41 years

Cumulative Discounted cash flow per Years



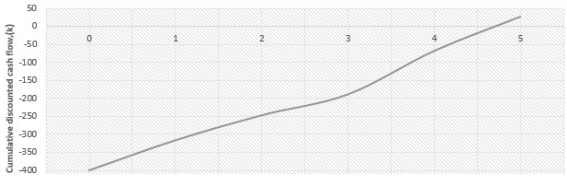
Discount cash flow for interest rate = 20%

Year	0	1	2	3	4	5
Cash Flow	-400	100	100	100	250	250
Discount Factor	1	0.833	0.694	0.579	0.482	0.402
Discounted Cash Flow (DCF),(k)	-400	83.30	69.40	57.90	120.50	100.50
Cumulative Discounted Cash Flow,(k)	-400	-316.70	-247.30	-189.40	-68.90	31.60

Net Present Value (NPV) = 31.60 in thousands

Payback Period (PP) = 4.23 years

Cumulative discounted cash flow per time



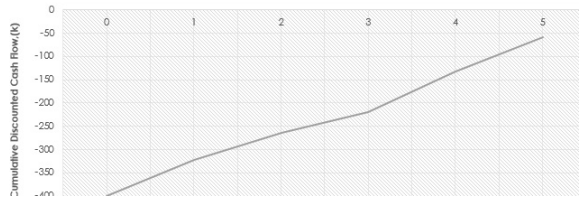
Discount cash flow for interest rate = 30%

Year	0	1	2	3	4	5
Cash Flow	-400	100	100	100	250	250
Discount Factor	1	0.769	0.592	0.445	0.35	0.296
Discounted Cash Flow (DCF),(k)	-400	76.90	59.20	44.50	87.50	74.00
Cumulative Discounted Cash Flow,(k)	-400	-323.10	-263.90	-219.40	-131.90	-57.90

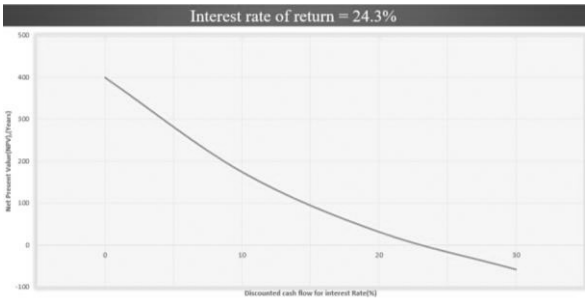
Net Present Value (NPV) = -57.90 in thousands

Payback Period (PP) = > 5 years

Cumulative Discounted Cash Flow per time

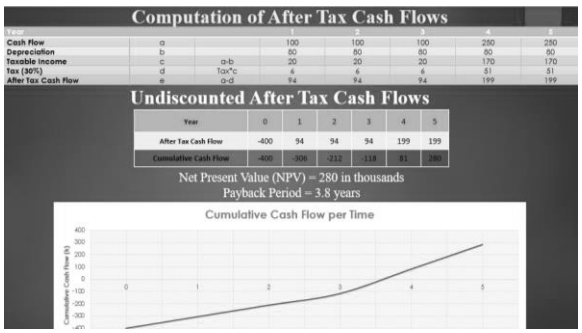


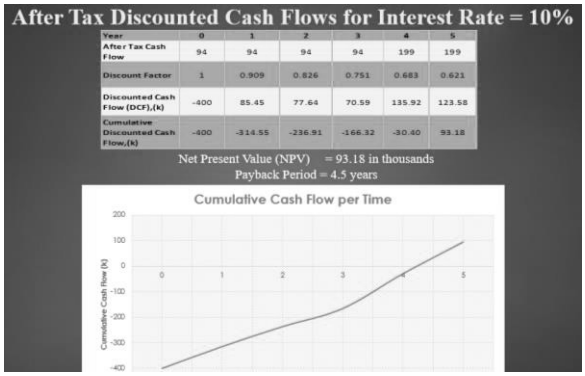
Interest rate of return = 24.3%

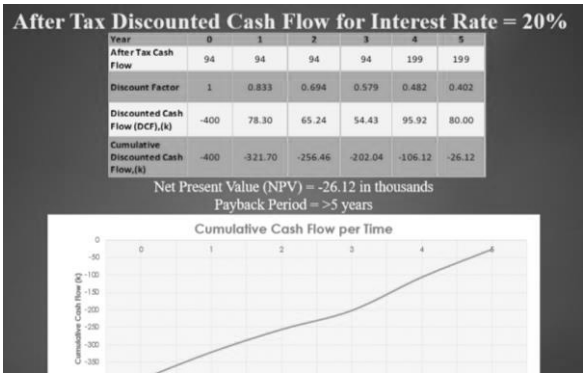


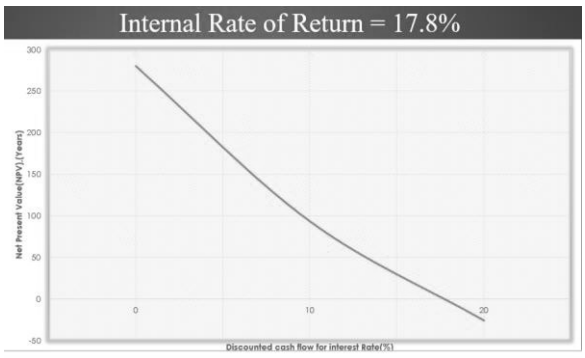
DEPRECIATION

Straight Line	80	80	80	80	80
Sum Digit	133.3	106.7	80	53.3	26.7
Declining Balance	400(0.4) =160	400(0.16) =64	400(0.064) =25.6	400(0.0256) =10.24	400(0.01024) =4.096









Conclusion: Therefore, the project A is more profitable than project B because it has the high net present value (NPV) and also the payback period (PP) is shorter. Moreover, the Internal Rate Return (IRR) of the project A is high compare to project B. In fact, more customers prefer the project A than project B because the price is affordable to everyone and it is also user friendly.

3.3 Hair Dryer

3.3.1 Project Charter

PROJECT CHARTER					
Project Title	Expert Hair Dryer	Project Manager			Dr. Mohd Yazid bin Abu
Project Start Date	20-9-2017	Project End Date	27-9-2017	Sponsor	UMP MALAYSIA
PROBLEM STATEMENT					
➔ The hairdryer that has been developed does not meet the need of many customers. Besides that, the payback period still undefined.					
OBJECTIVE					
➔ To determine the payback period of our product and also design a new product for the market.					
PROJECT SCOPE					
➔ This project will produce a marketable hairdryer for the customers and also get to know the payback period of the product.					
PROJECT TEAM					
Project Manager	Dr. Mohd Yazid bin Ahmad	Quality Manager	Tharsyini A/P Ramesh		
Safety Manger	Mohamad Nawawi Bin Nordin	Project Control	Siti Amal Syahirah Binti Mohd Asri		
Construction Manager	Chua Wei Ming	Engineering Manager	Putri Nur Shahida binti Mohd Asri		

3.3.2 Development Project Team

3.3.3 Comparison of Proposed Project

To develop a sophisticated hair dryer to meet market demand with:

1. Low Cost.
2. Various Colour as More Choice for Customers.
3. Detachable Concentrator.
4. Low Power Consumption.
5. Fordable for Easier Storage.
6. Heat and Power Control.

Scale of Evaluation

Very Poor	Poor	Fair	Average	Good	Excellent
0	1	2	3	4	5

Scoring of Alternative Projects

No.	Alternative Project	A	B	C	D	Total Score
1	Low Cost	4	5	1	1	11
2	Various Colour	5	2	2	2	11
3	Detachable Concentrator	4	2	5	4	15
4	Low Power Consumption	5	4	1	3	13
5	Fordable	3	3	5	3	14
6	Heat and Power Control	4	3	5	4	16

A: Attractiveness **B:** Cost **C:** Convenience **D:** Production Time

Project No.	Alternative Project	Points
6	Heat and Power Control	16
3	Detachable Concentrator	15
5	Fordable	14

3.3.4 Project Selection

Project Selection must have following criteria such as Net present value (NPV), Payback period (PP) and Internal rate return (IRR).

Project 1

The project has the following data:

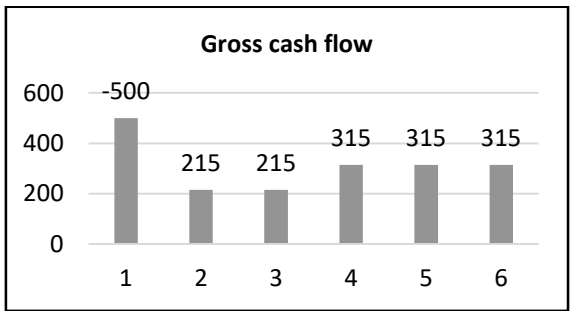
- Initial investment (I) = RM 500,000
- Annual cost of operation = RM35,000
- Planning horizon of 5 years

Expected annual revenues

- RM 250,000 for the first two years
- RM 350,000 for the next three years

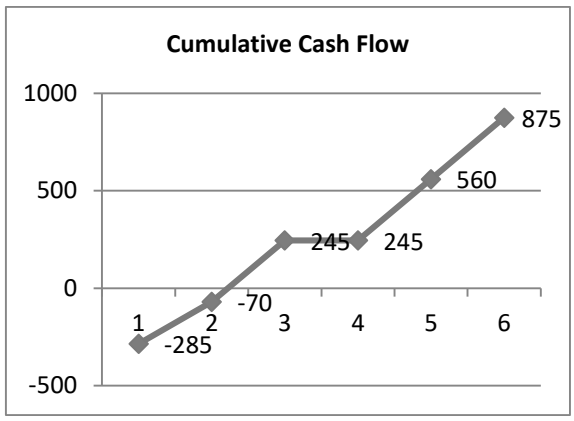
Year	0	1	2	3	4	5
Costs	-500	-35	-35	-35	-35	-35
Revenues		250	250	350	350	350

(All revenues and costs are in thousands of RM)



Undiscounted Cash Flows Before Tax

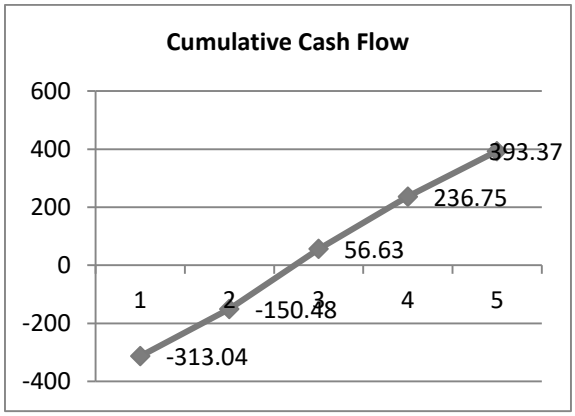
Years	0	1	2	3	4	5
Cash Flow	-500	215	215	315	315	315
Cumulative Cash Flow	-500	-285	-70	245	560	875



Discounted Cash Flows for Interest Rate = 15%

Year	0	1	2	3	4	5
Cash Flow	-500	215	215	315	315	315
Discount Factor	1	0.8696	0.7561	0.6575	0.5718	0.4972
Discounted Cash Flow (DCF)	-500	186.96	162.56	207.11	180.12	56.62
Cumulative Discounted Cash Flow	-500	-313.04	-150.48	56.63	236.75	393.37

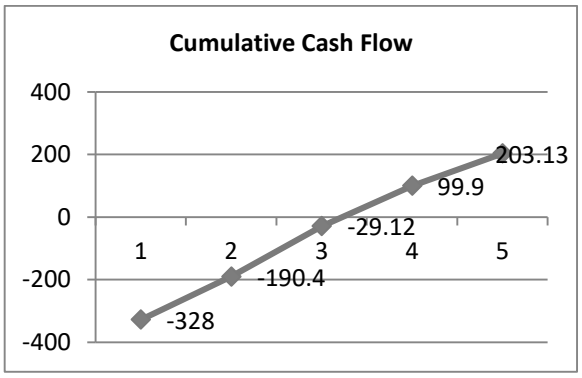
Net Present Value = 393.37 (in thousands)
Payback Period = 2.79 years



Discounted Cash Flows for Interest Rate = 25%

Year	0	1	2	3	4	5
Cash Flow	-500	215	215	315	315	315
Discount Factor	1	0.800	0.6400	0.5120	0.4096	0.3277
Discounted Cash Flow (DCF)	-500	172	137.60	161.28	129.02	103.23
Cumulative Discounted Cash Flow	-500	-328	-190.40	-29.12	99.90	203.13

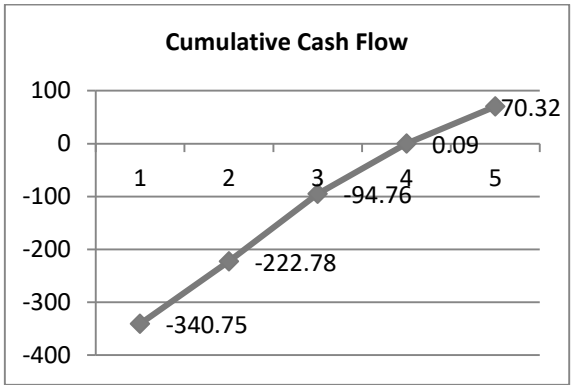
Net Present Value = 203.13 (in thousands)
Payback Period = 3.18 years



Discounted Cash Flows for Interest Rate = 35%

Year	0	1	2	3	4	5
Cash Flow	-500	215	215	315	315	315
Discount Factor	1	0.7407	0.5487	0.4064	0.3011	0.2230
Discounted Cash Flow (DCF)	-500	159.25	117.97	128.02	94.85	70.23
Cumulative Discounted Cash Flow	-500	-340.75	-222.78	-94.76	0.09	70.32

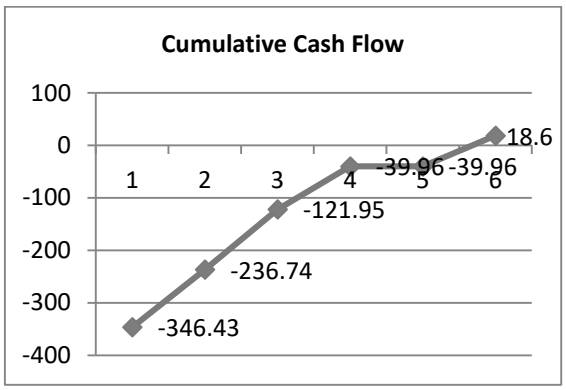
Net Present Value = 70.32 (in thousands)
Payback Period = 4 years



Discounted Cash Flows for Interest Rate = 40%

Year	0	1	2	3	4	5
Cash Flow	-500	215	215	315	315	315
Discount Factor	1	0.7143	0.5012	0.3644	0.2603	0.1859
Discounted Cash Flow (DCF)	-500	153.57	109.69	114.79	81.99	58.56
Cumulative Discounted Cash Flow	-500	-346.43	-236.74	-121.95	-39.96	18.6

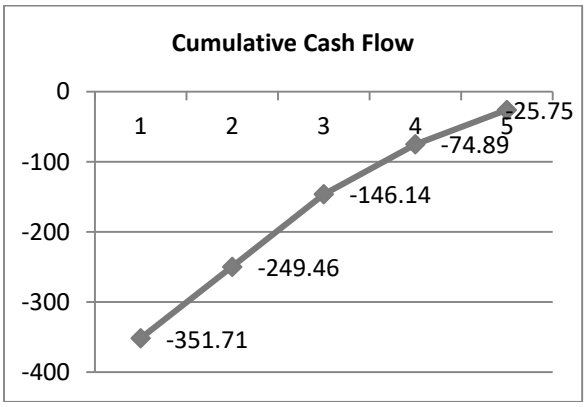
Net Present Value = 18.60 (in thousands)
Payback Period =>5 years

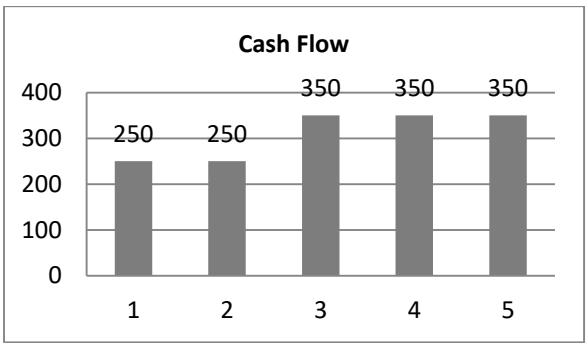


Discounted Cash Flows for Interest Rate = 45%

Year	0	1	2	3	4	5
Cash Flow	-500	215	215	315	315	315
Discount Factor	1	0.6897	0.4756	0.3280	0.2262	0.1560
Discounted Cash Flow (DCF)	-500	148.29	102.25	103.32	71.25	49.14
Cumulative Discounted Cash Flow	-500	-351.71	-249.46	-146.14	-74.89	-25.75

Net Present Value = -25.75 (in thousands)
Payback Period => 5 years





Depreciation

Straight Line	60	60	60	60	60

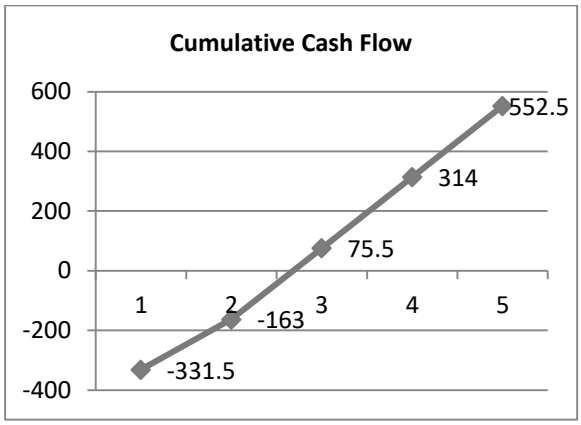
Cash Flow after Tax

Year	1	2	3	4	5
Cash Flow	215	215	315	315	315
Depreciation	60	60	60	60	60
Taxable Income	155	155	255	255	255
Tax (30%)	46.5	46.5	76.5	76.5	76.5
After Tax Cash Flow	168.5	168.5	238.5	238.5	238.5

Undiscounted Cash Flows after Tax

Year	0	1	2	3	4	5
After Tax Cash Flow	-500	168.5	168.5	238.5	238.5	238.5
Cumulative Cash Flow	-500	-331.5	-163	75.50	314	552.50

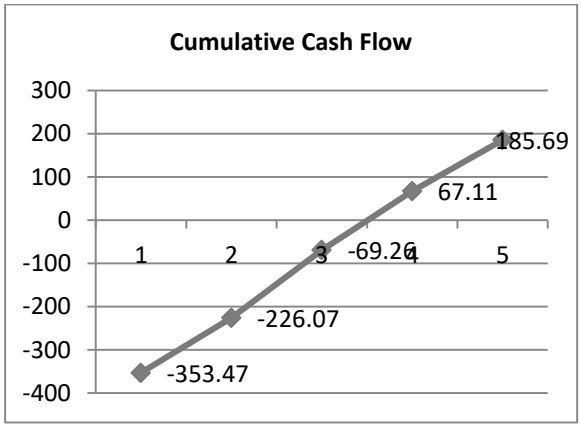
Net Present Value = 552.50 (in thousands)
Payback Period = 2.56 years



After Tax Discounted Cash Flows for Interest Rate = 15%

Year	0	1	2	3	4	5
After Tax Cash Flow	-500	168.5	168.5	238.5	238.5	238.5
Discount Factor	1	0.8696	0.7561	0.6575	0.5718	0.4972
Discounted Cash Flow (DCF)	-500	146.53	127.40	156.81	136.37	118.58
Cumulative DCF	-500	-353.47	-226.07	-69.26	67.11	185.69

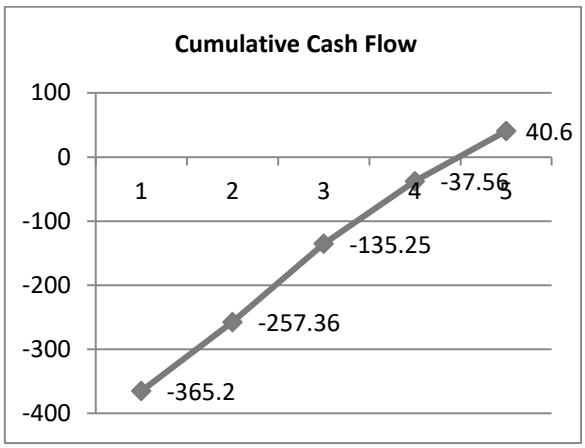
Net Present Value = 385.69 (in thousands)
Payback Period = 3.5 years



After Tax Discounted Cash Flows for Interest Rate = 25%

Year	0	1	2	3	4	5
After Tax Cash Flow	-500	168.5	168.5	238.5	238.5	238.5
Discount Factor	1	0.800	0.6400	0.5120	0.4096	0.3277
Discounted Cash Flow (DCF)	-500	134.80	107.84	122.11	97.69	78.16
Cumulative DCF	-500	-365.20	-257.36	-135.25	-37.56	40.60

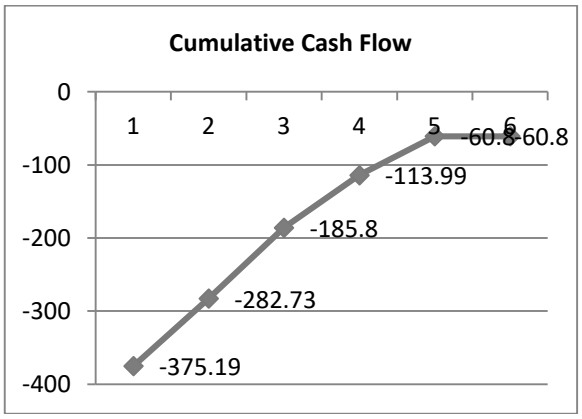
Net Present Value = 40.60 (in thousands)
Payback Period = 4.5 years



After Tax Discounted Cash Flows for Interest Rate = 35%

Year	0	1	2	3	4	5
After Tax Cash Flow	-500	168.5	168.5	238.5	238.5	238.5
Discount Factor	1	0.7407	0.5487	0.4064	0.3011	0.2230
Discounted Cash Flow (DCF)	-500	124.81	92.46	96.93	71.81	53.19
Cumulative DCF	-500	-375.19	-282.73	-185.80	-113.99	-60.80

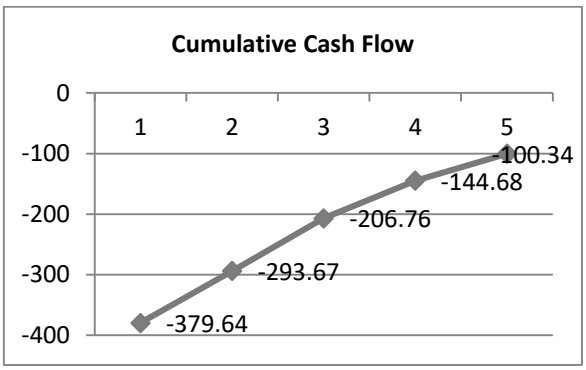
Net Present Value (NPV) = -60.8 (in thousands)
Payback Period => 5 years



After Tax Discounted Cash Flows for Interest Rate = 40%

Year	0	1	2	3	4	5
After Tax Cash Flow	-500	168.5	168.5	238.5	238.5	238.5
Discount Factor	1	0.7145	0.5102	0.3644	0.2603	0.1859
Discounted Cash Flow (DCF)	-500	120.36	85.97	86.91	62.08	44.34
Cumulative DCF	-500	-379.64	-293.67	-206.76	-144.68	-100.34

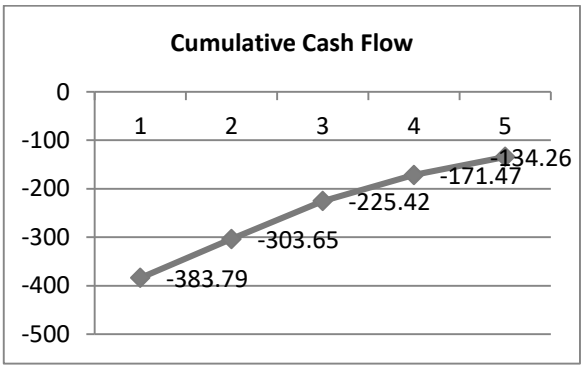
Net Present Value (NPV) = -100.34 (in thousands)
Payback Period = > 5 years

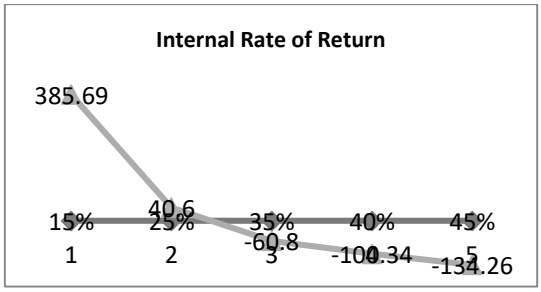


After Tax Discounted Cash Flows for Interest Rate = 45%

Year	0	1	2	3	4	5
After Tax Cash Flow	-500	168.5	168.5	238.5	238.5	238.5
Discount Factor	1	0.6897	0.4756	0.3280	0.2262	0.1560
Discounted Cash Flow (DCF)	-500	116.21	80.14	78.23	53.95	37.21
Cumulative DCF	-500	-383.79	-303.65	-225.42	-171.47	-134.26

Net Present Value (NPV) = -134.26 (in thousands)
Payback Period = > 5 years





IRR = 25.35%

Project 2

The project has the following data:

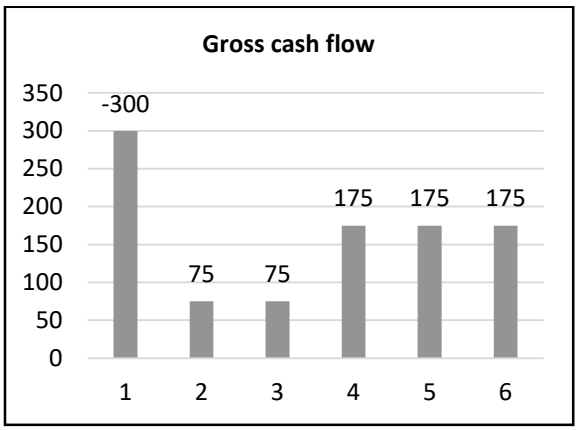
- Initial investment (I) = RM 300,000
- Annual cost of operation = RM25,000
- Planning horizon of 5 years

Expected annual revenues

- RM100,000 for the first two years
- RM200,000 for the next three years

Year	0	1	2	3	4	5
Costs	-300	-25	-25	-25	-25	-25
Revenues		100	100	200	200	200

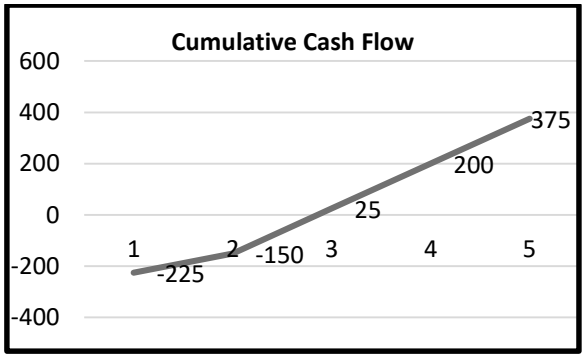
(All revenues and costs are in thousands of RM)



Undiscounted Cash Flows Before Tax

Year	1	2	3	4	5	6
Cash Flow	-300	75	75	175	175	175
Cumulative Cash Flow	-300	-225	-150	25	200	375

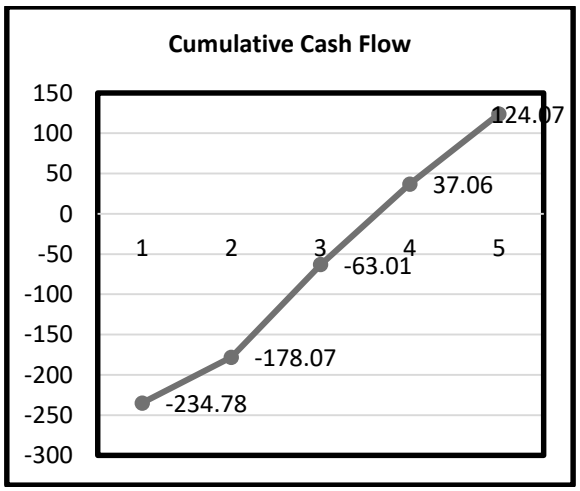
Net present value (NPV) = 375 (in thousands)
Payback Period = 3.5 years



Discounted Cash Flows for Interest Rate = 15%

Year	0	1	2	3	4	5
Cash Flow	-300	75	75	175	175	175
Discount Factor	1	0.8696	0.7561	0.6575	0.5718	0.4972
Discounted Cash Flow (DCF)	-300	65.22	56.71	115.06	100.07	87.01
Cumulative Discounted Cash Flow	-300	-234.78	-178.07	-63.01	37.06	124.07

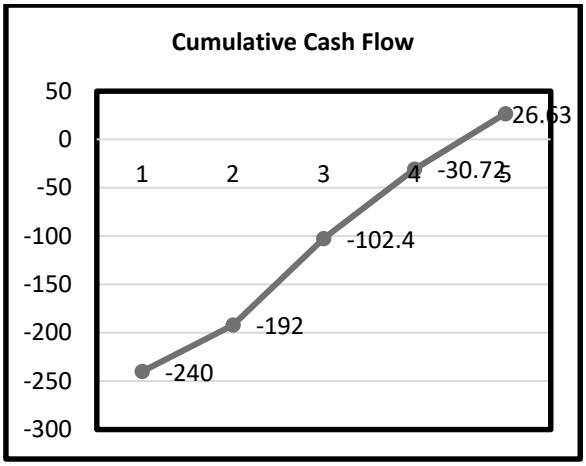
Net present value (NPV) = 124.07 (in thousands)
Payback Period = 3.5 years



Discounted Cash Flows for Interest Rate = 25%

Year	0	1	2	3	4	5
Cash Flow	-300	75	75	175	175	175
Discount Factor	1	0.800	0.6400	0.5120	0.4096	0.3277
Discounted Cash Flow (DCF)	-300	60	48	89.6	71.68	57.35
Cumulative Discounted Cash Flow	-300	-240	-192	-102.4	-30.72	26.63

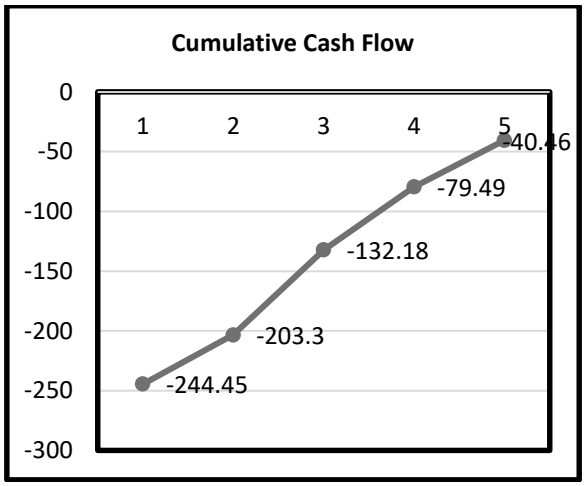
Net present value (NPV) = 26.63 (in thousands)
Payback Period = 4.5 years



Discounted Cash Flows for Interest Rate = 35%

Year	0	1	2	3	4	5
Cash flow	-300	75	75	175	175	175
Discount factor	1	0.7407	0.5487	0.4064	0.3011	0.2230
Discounted Cash Flow (DCF)	-300	55.55	41.15	71.12	52.69	39.03
Cumulative Discounted Cash Flow	-300	-244.45	-203.3	-132.18	-79.49	-40.46

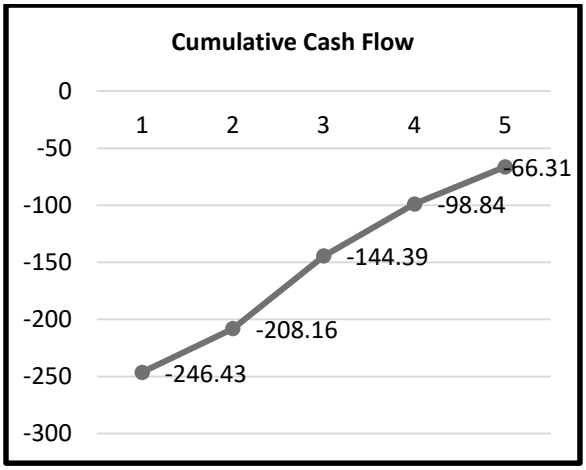
Net Present Value(NPV) = -40.46 (in thousands)
Payback Period = more than 5 years



Discounted Cash Flows for Interest Rate = 40%

Year	0	1	2	3	4	5
Cash flow	-300	75	75	175	175	175
Discount factor	1	0.7143	0.5102	0.3644	0.2603	0.1859
Discounted Cash Flow (DCF)	-300	53.57	38.27	63.77	45.55	32.53
Cumulative Discounted Cash Flow	-300	-246.43	-208.16	-144.39	-98.84	-66.31

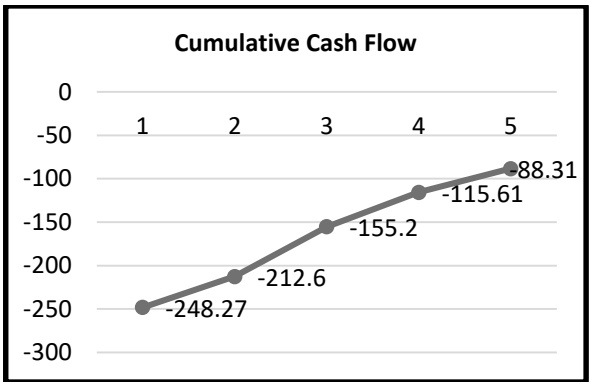
Net Present Value (NPV) = -66.31 (in thousands)
Payback Period = more than 5 years

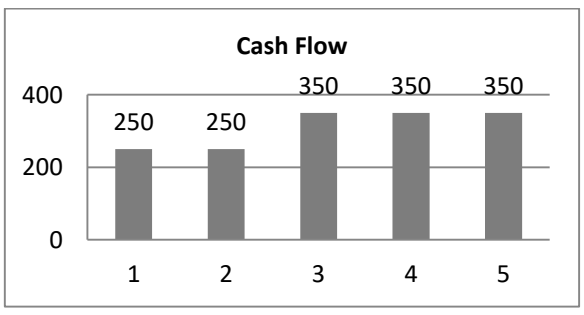


Discounted Cash Flows for Interest Rate = 45%

Year	0	1	2	3	4	5
Cash flow	-300	75	75	175	175	175
Discount factor	1	0.6897	0.4756	0.3280	0.2262	0.1560
Discounted Cash Flow (DCF)	-300	51.73	35.67	57.4	39.59	27.3
Cumulative Discounted Cash Flow	-300	-248.27	-212.6	-155.2	-115.61	-88.31

Net Present Value (NPV) = -88.31 (in thousands)
Payback Period = more than 5 years





Depreciation

Straight Line	60	60	60	60	60

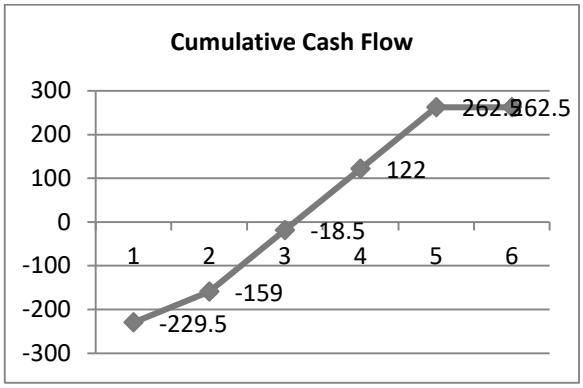
Cash Flow After Tax

Year	1	2	3	4	5
Cash Flow	75	75	175	175	175
Depreciation	60	60	60	60	60
Taxable Income	15	15	115	115	115
Tax (30%)	4.5	4.5	34.5	34.5	34.5
After Tax Cash Flow	70.5	70.5	140.5	140.5	140.5

Undiscounted Cash Flows After Tax

Year	0	1	2	3	4	5
After Tax Cash Flow	-300	70.5	70.5	140.5	140.5	140.5
Cumulative Cash Flow	-300	-229.5	-159	-18.5	122	262.5

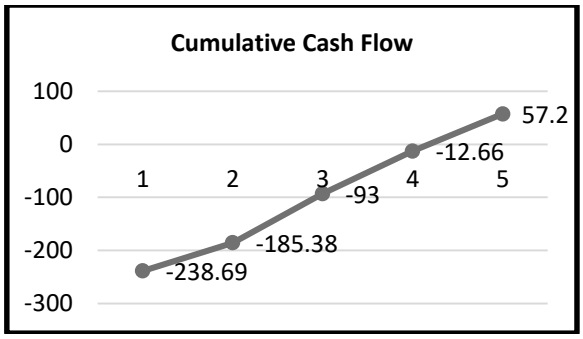
Net Present Value (NPV) = 262.5 (in thousands)
Payback Period = 3.19 years



After Tax Discounted Cash Flows for Interest Rate = 15%

Year	0	1	2	3	4	5
After Tax Cash Flow	-300	70.5	70.5	140.5	140.5	140.5
Discount factor	1	0.8696	0.7561	0.6575	0.5718	0.4972
Discounted Cash Flow (DCF)	-300	61.31	53.31	92.38	80.34	69.86
Cumulative Discounted Cash Flow	-300	-238.69	-185.38	-93	-12.66	57.2

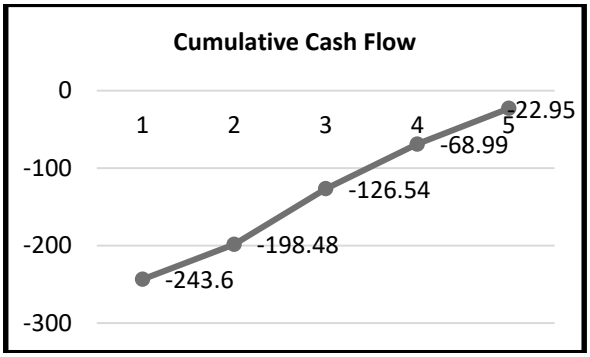
Net Present Value (NPV) = 57.2 (in thousands)
Payback Period = 4.2 years



After Tax Discounted Cash Flows for Interest Rate = 25%

Year	0	1	2	3	4	5
After Tax Cash Flow	-300	70.5	70.5	140.5	140.5	140.5
Discount factor	1	0.800	0.6400	0.5120	0.4096	0.3277
Discounted Cash Flow (DCF)	-300	56.4	45.12	71.94	57.55	46.04
Cumulative Discounted Cash Flow	-300	-243.6	-198.48	-126.54	-68.99	-22.95

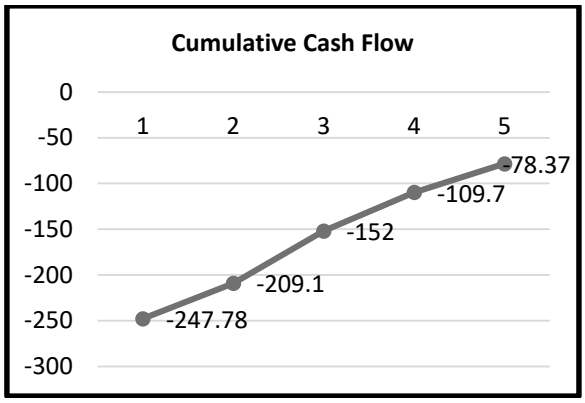
Net Present Value (NPV) = -22.95 (in thousands)
Payback Period = more than 5 years



After Tax Discounted Cash Flows for Interest Rate = 35%

Year	0	1	2	3	4	5
After Tax Cash Flow	-300	70.5	70.5	140.5	140.5	140.5
Discount factor	1	0.7407	0.5487	0.4064	0.3011	0.2230
Discounted Cash Flow (DCF)	-300	52.22	38.68	57.10	42.30	31.33
Cumulative Discounted Cash Flow	-300	-247.78	-209.1	-152	-109.7	-78.37

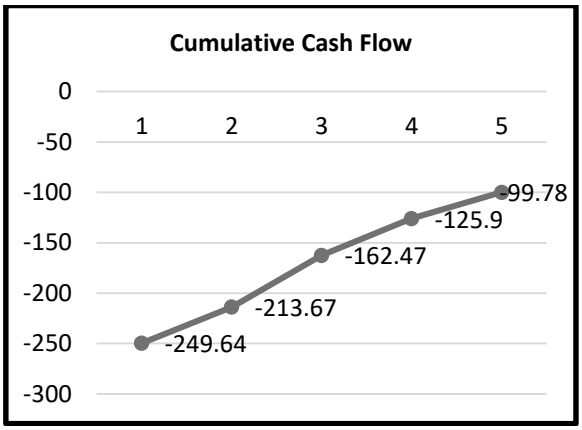
Net Present Value (NPV) = -78.37 (in thousands)
Payback Period = more than 5 years



After Tax Discounted Cash Flows for Interest Rate = 40%

Year	0	1	2	3	4	5
After Tax Cash Flow	-300	70.5	70.5	140.5	140.5	140.5
Discount factor	1	0.7143	0.5102	0.3644	0.2603	0.1859
Discounted Cash Flow (DCF)	-300	50.36	35.97	51.20	36.57	26.12
Cumulative Discounted Cash Flow	-300	-249.64	-213.67	-162.47	-125.9	-99.78

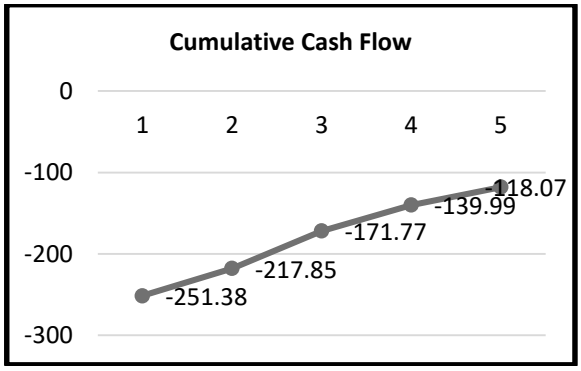
Net Present Value (NPV) = -99.78 (in thousands)
Payback Period = more than 5 years

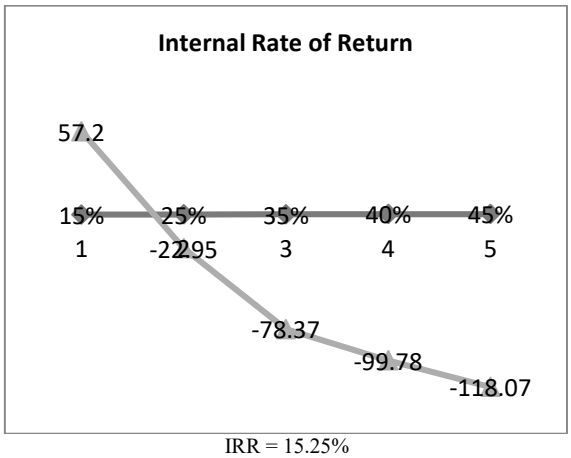


After Tax Discounted Cash Flows for Interest Rate = 45%

Year	0	1	2	3	4	5
After Tax Cash Flow	-300	70.5	70.5	140.5	140.5	140.5
Discount factor	1	0.6897	0.4756	0.3280	0.2262	0.1560
Discounted Cash Flow (DCF)	-300	48.62	33.53	46.08	31.78	21.92
Cumulative Discounted Cash Flow	-300	-251.38	-217.85	-171.77	-139.99	-118.07

Net Present Value (NPV) = -118.07 (in thousands)
Payback Period = more than 5 years





IRR = 15.25%

Conclusion:
Based on the sample project 1 and project 2 data obtained that is Net present value (NPV), Payback period (PP) and Internal rate return (IRR). The conclusion can be made from this value by comparing the value of data obtained.

Sample Project 1		Sample Project 2
The value after Tax Discounted cash flows for Interest Rate 25% is NPV RM 40.60 in thousands (positive) that is higher than Sample project 2 and it is a good value of decision for NPV.	NPV	The value after Tax Discounted cash flows for Interest Rate 25% is NPV 22.95 in thousands (negative) that is not good the (NPV) value must be higher to get a good result.
Value of the sample project 1 payback is shorter than the sample project 2 that is a good decision for the company to get their payback faster.	PP	Value of the sample project 2 payback period is longer than the sample project 1 that is more than 5 years that is longer which is not a good decision.
25.35% that is more higher than the sample project 2 value with is it is a good decision for company	IRR	15.25% lower than the value of the sample project 1 , that means the value is not good for the rate return for the money spend.

3.4 Touch Light

3.4.1 Project Charter

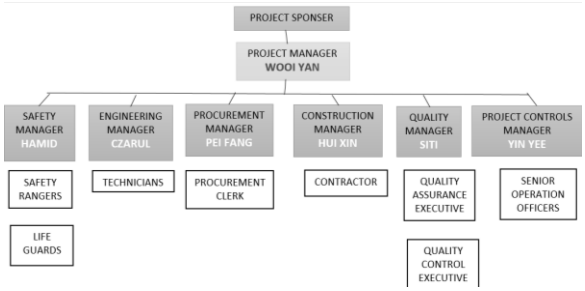
To develop a useful flashlight especially for hiking and camping purposes:

- #1 Smaller body size
- #2 Substitute brighter colour to body of flashlight
- #3 Change the position of switch assembly to upper side of product
- #4 Presence of zoom-in and out feature
- #5 Lining on the body for better grip

Scope:

•Mainly to target customers that use it for hiking or camping purposes
•Selling price to be controlled within RM 10 - RM 15
•Materials used for body of flashlight are limited to ABS plastic and aluminium
•General processes carried out are raw material kitting, lathing, turning, milling, and plastic injection process

3.4.2 Development Project Team



3.4.3 Comparison of Proposed Project

Evaluation Scale							
Level	No relation	Poor	Fair	Average	Good	Excellent	Level
	0	1	2	3	4	5	
Low	Quality						High
Low	Attractive exterior						High
Not convenient	Convenience						User-friendly
High	Cost						Low
Long	Time consuming						Short

Scoring of Alternative Projects above						
	A	B	C	D	E	Total
#1	0	4	5	4	4	17
#2	2	5	3	2	2	14
#3	3	3	3	3	3	15
#4	4	3	5	1	3	16
#5	4	5	1	2	1	13

	Hint:
A	Quality
B	Attractive exterior
C	Convenience
D	Cost
E	Time consuming

Results of Screening:
Project # 1 Smaller body size
Project # 4 Presence of zoom-in and out feature
Project # 3 Change the position of switch assembly to upper side of product

3.4.4 Project Selection

Evaluation through Project # 1:

- Initial investment: RM250,000
- Annual cost of operation: RM10,000
- Planning horizon of 5 years

Expected annual revenues:

- RM100,000 for the first two year
- RM150,000 for the next three year

Year	**0**	**1**	**2**	**3**	**4**	**5**
Costs	-250	-10	-10	-10	-10	-10
Revenues	-	100	100	150	150	150

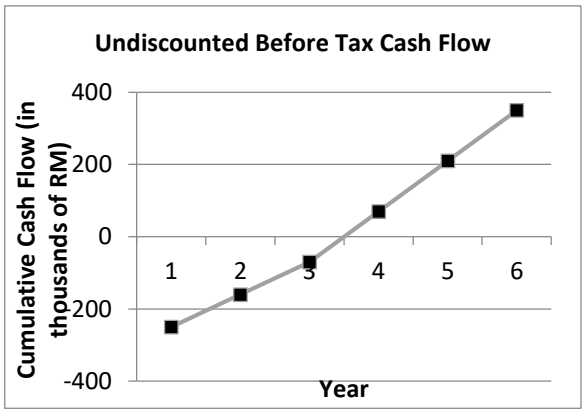
(All revenues and costs are in thousands of RM)

Undiscounted Cash Flows before Tax

Year	**0**	**1**	**2**	**3**	**4**	**5**
Cash Flow	-250	90	90	140	140	140
Cumulative Cash Flow	-250	-160	-70	70	210	350

(All revenues and costs are in thousands of MYR)

Net present value (NPV): RM 250 (in thousands)
Payback Period (PP): 3.5 years

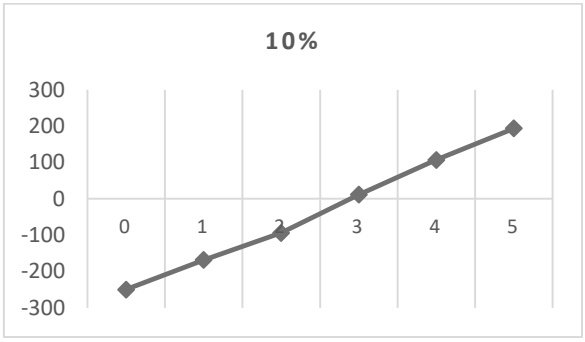


Discount Cash flow for interest rate 10%

Year	0	1	2	3	4	5
Cash Flow(RM)	-250	90	90	140	140	140
Discount Factor	1	0.909	0.826	0.751	0.683	0.621
DCF	-250	81.81	74.34	105.14	95.62	86.94
Cumulative	-250	-168.19	-93.85	11.29	106.91	193.85

(All revenues and costs are in thousands of MYR)

Net present value(NPV)= RM 193.85
Payback Period= 2.8 Years

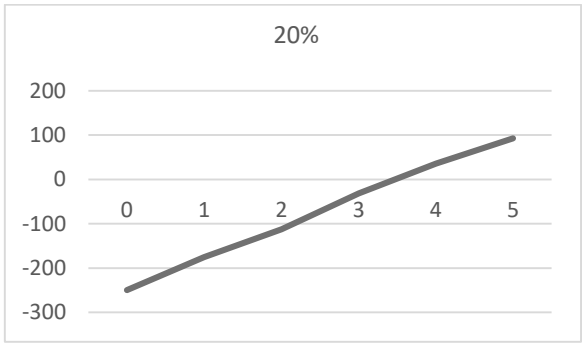


Discount Cash flow for interest rate 20%

Year	0	1	2	3	4	5
Cash flow(RM)	-250	90	90	140	140	140
Discount factor	1	0.833	0.694	0.579	0.482	0.402
DCF	-250	74.97	62.46	81.06	67.48	58.28
Cumulative	-250	-175.03	-112.57	-31.51	35.79	92.25

(All revenues and costs are in thousands of MYR)

Net present value(NPV) = RM 92.25
Payback Period = 3.49 Years

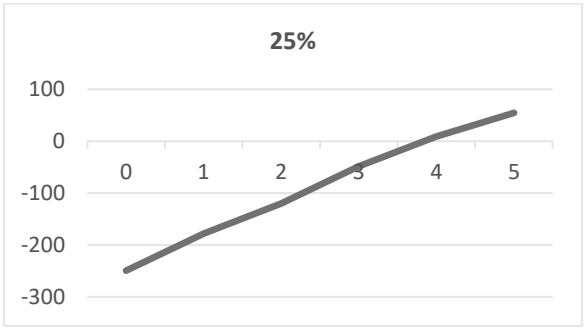


Discount Cash flow for interest rate 25%

Year	0	1	2	3	4	5
Cash Flow (RM)	-250	90	90	140	140	140
Discount Flow	1	0.8	0.64	0.512	0.41	0.328
DCF	-250	72	57.6	71068	57.4	45.92
Cumulative	-250	-178	-120.4	-48.72	8.68	54.6

(All revenues and costs are in thousands of MYR)

Net present value(NPV) = RM 54.6
Payback Period = 3.9 Years

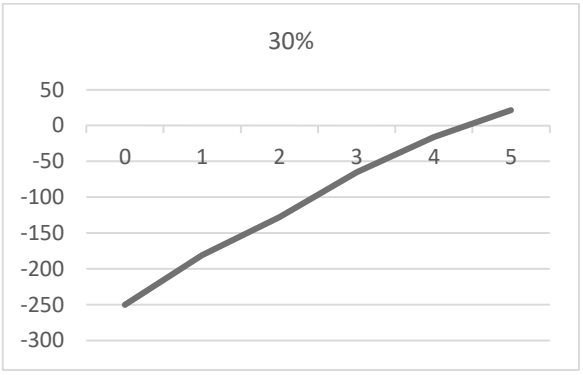


Discount Cash flow for interest rate 30%

Year	0	1	2	3	4	5
Cash Flow (RM)	-250	90	90	140	140	140
Discount Flow	1	0.769	0.592	0.445	0.35	0.269
DCF	-250	69.21	53.28	62.3	49	37.66
Cumulative	-250	-180.79	-127.51	-65.21	-16.21	21.45

(All revenues and costs are in thousands of MYR)

Net present value(NPV) = RM 21.45
Payback Period = 4.44 Years

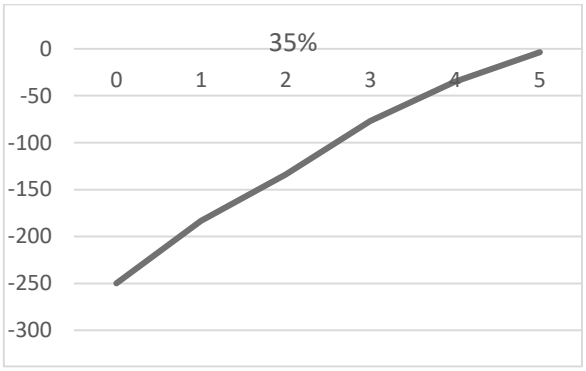


Discount Cash flow for interest rate 35%

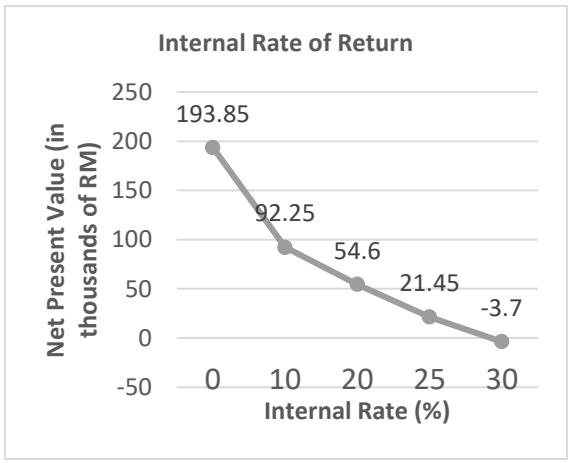
Year	0	1	2	3	4	5
Cash Flow(RM)	-250	90	90	140	140	140
Discount Flow	1	0.741	0.549	0.406	0.301	0.223
DCF	-250	66.69	49.41	56.84	42.14	31.22
Cumulative	-250	-183.31	-133.9	-77.06	-34.92	-3.7

(All revenues and costs are in thousands of MYR)

Net present value(NPV) = RM-3.70
Payback Period = >5 Years



Internal Rate of Return (IRR)



IRR = 29.5%

	1	2	3	4	5
Straight line	50	50	50	50	50

Computation of After Tax Cash Flows

Year	**1**	**2**	**3**	**4**	**5**
Cash Flow	90	90	140	140	140
Depreciation	50	50	50	50	50
Taxable Income	40	40	90	90	90
Tax (30%)	12	12	27	27	27
After tax cash flow	78	78	113	113	113

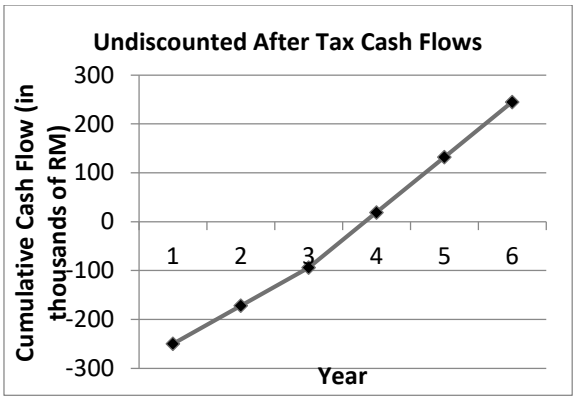
(All cash flows are in thousands of MYR)

Undiscounted After Tax Cash Flows

Year	0	1	2	3	4	5
After Tax Cash Flow	-250	78	78	113	113	113
Cumulative Cash Flow	-250	-172	-94	19	132	245

(All revenues and costs are in thousands of MYR)

Net present value (NPV): RM 245 (in thousands)
Payback Period (PP): 3.8 years

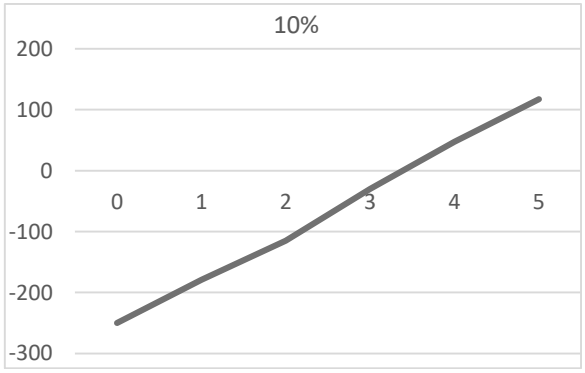


Discount After Tax for interest rate 10%

Year	0	1	2	3	4	5
Cash Flow(RM)	-250	78	78	113	113	113
Discount Factor	1	0.909	0.826	0.751	0.683	0.621
DCF	-250	70.9	64.43	84.86	77.18	70.17
Cumulative	-250	-179.1	-114.67	-29.81	47.34	117.54

(All revenues and costs are in thousands of MYR)

Net present value(NPV) = RM 117.54
Payback Period = 3.34 Years

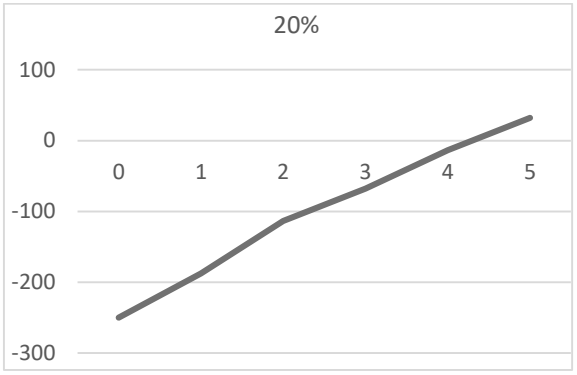


Discount After Tax for interest rate 20%

Year	0	1	2	3	4	5
Cash flow(RM)	-250	78	78	113	113	113
Discount factor	1	0.803	0.694	0.579	0.482	0.402
DCF	-250	62.63	54.13	65.13	54.46	45.43
Cumulative	-250	-187.3	-113.2	-67.8	-13.3	32.09

(All revenues and costs are in thousands of MYR)

Net present value(NPV) = RM 32.09
Payback Period = 4.25 Years

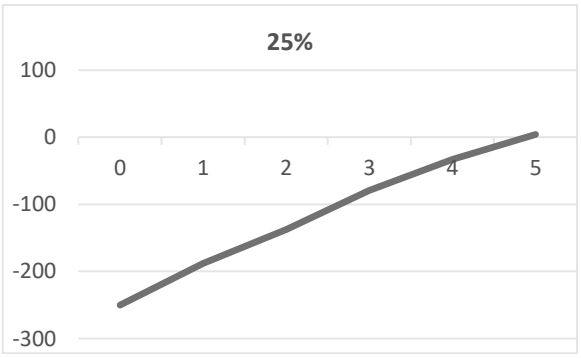


Discount After Tax for interest rate 25%

Year	0	1	2	3	4	5	
Cash Flow(RM)	-250	78	78	113	113	113	
Discount Flow	1	0.8	0.64	0.512	0.41	0.328	
DCF	-250	62.8	49.92	57.86	46.33	37.06	
Cumulative	-250	-188.2	-137.28	-79.42	-33.09	3.97	

(All revenues and costs are in thousands of MYR)

Net present value(NPV) = RM 3.97
Payback Period = 4.96 Years

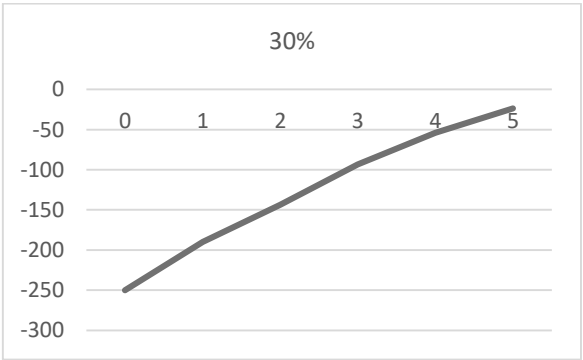


Discount After Tax for interest rate 30%

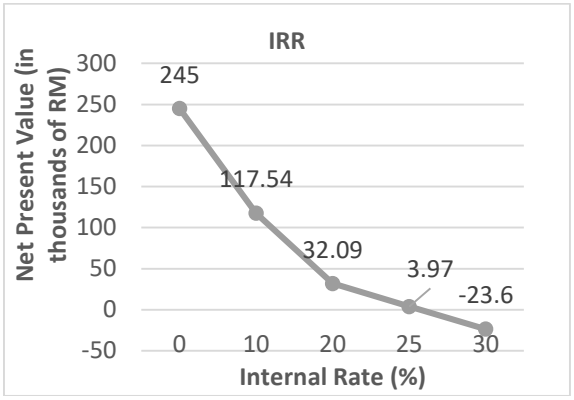
Year	0	1	2	3	4	5
Cash Flow (RM)	-250	78	78	113	113	113
Discount Flow	1	0.769	0.592	0.445	0.35	0.269
DCF	-250	59.95	46.18	50.29	39.55	30.4
Cumulative	-250	-190.02	-143.84	-93.55	-54	-23.6

(All revenues and costs are in thousands of MYR)

Net present value(NPV) = RM -23.60
Payback Period =>5 years



Internal Rate of Return (IRR)



IRR = 25.63%

Evaluation through Project # 4:

- Initial investment (I): RM350,000
- Annual cost of operation: RM25,000
- Planning horizon of 5 years

Expected annual revenues:

- RM150,000 for the first two year
- RM200,000 for the next three year

Year	0	1	2	3	4	5
Costs	-350	-25	-25	-25	-25	-25
Revenues		150	150	200	200	200
Cash Flow	-350	125	125	175	175	175

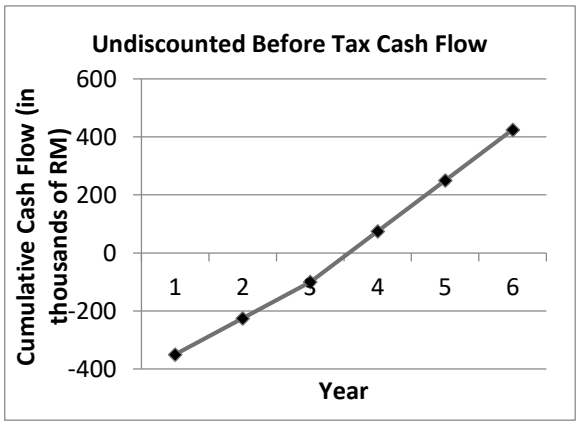
(All revenues and costs are in thousands of RM)
Gross Cash Flows

Undiscounted Cash Flows before Tax

Year	0	1	2	3	4	5
Cash Flow	-350	125	125	175	175	175
Cumulative Cash Flow	-350	-225	-100	75	250	425

(All cash flows are in thousands of RM)

Net present value (NPV): RM 425 (in thousands)
Payback Period (PP): 3.5 years

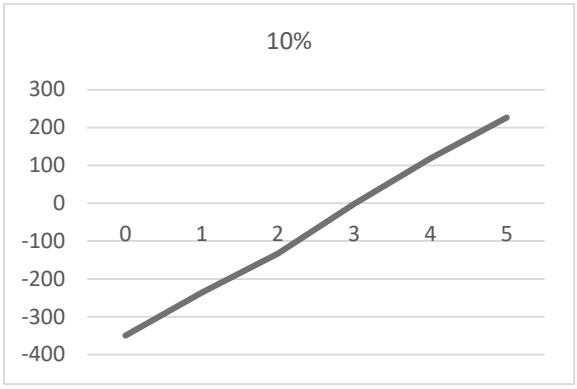


Discount Cash flow for interest rate 10%

Year	0	1	2	3	4	5
Cash Flow(RM)	-350	125	125	175	175	175
Discount Factor	1	0.909	0.826	0.751	0.683	0.621
DCF	-350	113.63	103.25	131.43	119.53	108.6
Cumulative	-350	-236.37	-133.12	-1.69	117.84	226.52

(All revenues and costs are in thousands of MYR)

Net present value(NPV) = RM 226.52
Payback Period = 3.15

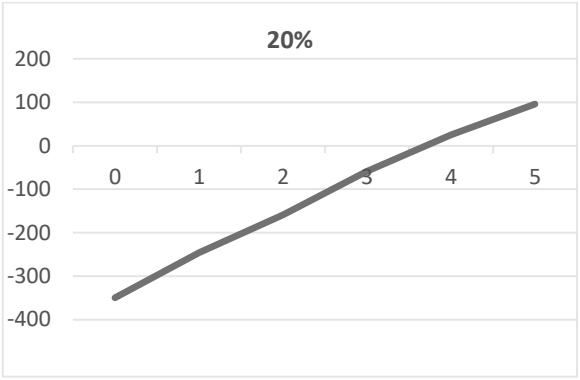


Discount Cash flow for interest rate 20%

Year	0	1	2	3	4	5
Cash flow(RM)	-350	125	125	175	175	175
Discount factor	1	0.833	0.694	0.573	0.482	0.402
DCF	-350	104.13	86.75	100.28	84.35	70.35
Cumulative	-350	-245.82	-159.12	-58.84	25.51	95.86

(All revenues and costs are in thousands of MYR)

Net present value(NPV) = RM 95.86
Payback Period = 3.73 Years

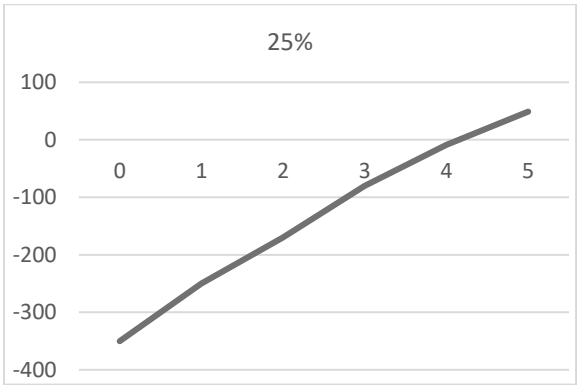


Discount Cash flow for interest rate 25%

Year	0	1	2	3	4	5
Cash Flow(RM)	-350	125	125	175	175	175
Discount Flow	1	0.8	0.64	0.512	0.41	0.328
DCF	-350	100	80	8906	71075	5704
Cumulative	-350	-250	-170	-804	-8.65	48.85

(All revenues and costs are in thousands of MYR)

Net present value(NPV) = RM 48.85
Payback Period = 4.13 Years

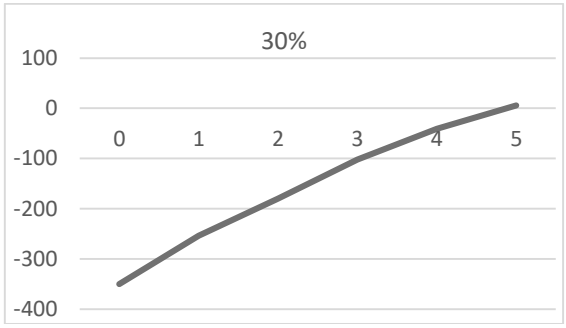


Discount Cash flow for interest rate 30%

Year	0	1	2	3	4	5
Cash Flow(RM)	-350	125	125	175	175	175
Discount Flow	1	0.769	0.592	0.445	0.35	0.2669
DCF	-350	96.13	84	77.88	61.25	46.81
Cumulative	-350	-253.87	-179.88	-101.99	-40.74	5.97

(All revenues and costs are in thousands of MYR)

Net present value(NPV) = RM 5.97
Payback Period = 4.91 Years

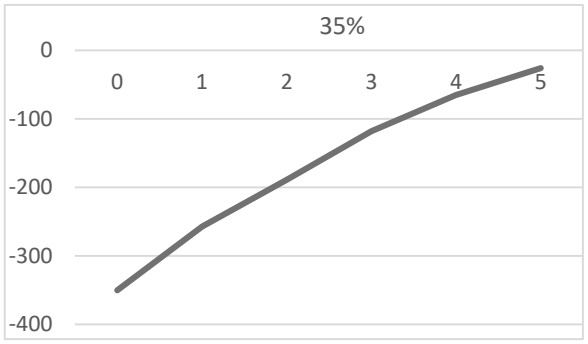


Discount Cash flow for interest rate 35%

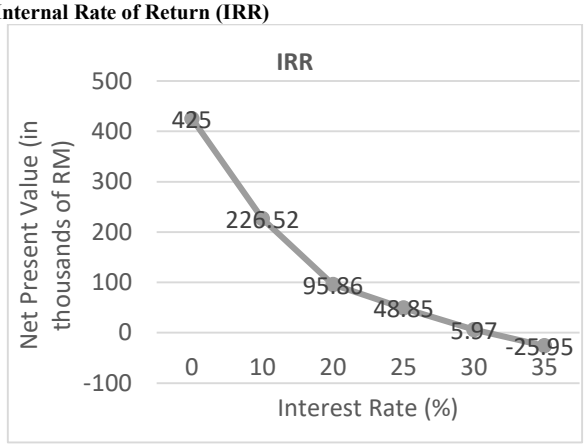
Year	0	1	2	3	4	5
Cash Flow(RM)	-350	125	125	175	175	175
Discount Flow	1	0.741	0.549	0.406	0.301	0.223
DCF	-350	92.63	69.63	71.05	52.68	39.03
Cumulative	-350	-257.37	-188.74	-117.69	-65.01	-25.95

(All revenues and costs are in thousands of MYR)

Net present value(NPV) = RM -25.95
Payback Period = >5 Years



Internal Rate of Return (IRR)



IRR = 25.3%

Computation of After Tax Cash Flows

Year	1	2	3	4	5
Cash Flow (a)	125	125	175	175	175
Depreciation (b)	70	70	70	70	70
Taxable Income (c)	55	55	95	95	95
Tax (30%) (d)	16.5	16.5	28.5	28.5	28.5
After tax cash flow (e)	108.5	108.5	146.5	146.5	146.5

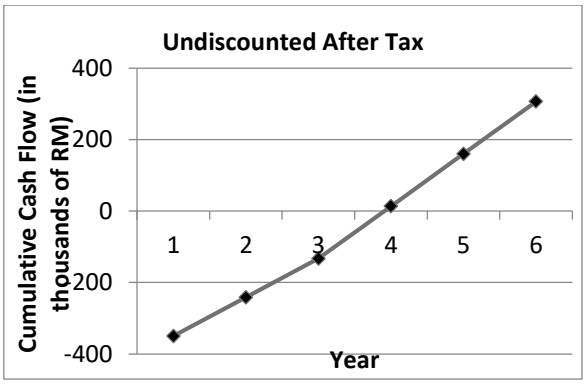
(All cash flows are in thousands of MYR)

Undiscounted After Tax Cash Flows

Year	**0**	**1**	**2**	**3**	**4**	**5**
After Tax Cash Flow	-350	108.5	108.5	146.5	146.5	146.5
Cumulative Cash Flow	-350	-241.5	-133	13.5	160	306.5

(All revenues and costs are in thousands of MYR)

Net present value (NPV): RM 306.5 (in thousands)
Payback Period (PP): 3.9 years

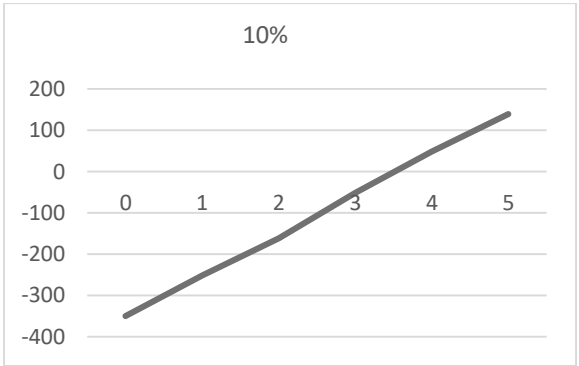


Discount After Tax for interest rate 10%

Year	0	1	2	3	4	5
Cash Flow (RM)	-350	108.5	146.5	146.5	146.5	146.5
Discount Factor	1	0.909	0.826	0.85	0.683	0.621
DCF	-350	98.63	89.62	110.02	100.06	90.98
Cumulative	-350	-251.37	-161.85	-51.83	48.33	139.31

(All revenues and costs are in thousands of MYR)

Net present value(NPV) = 139.31
Payback Period = 3.4 Years

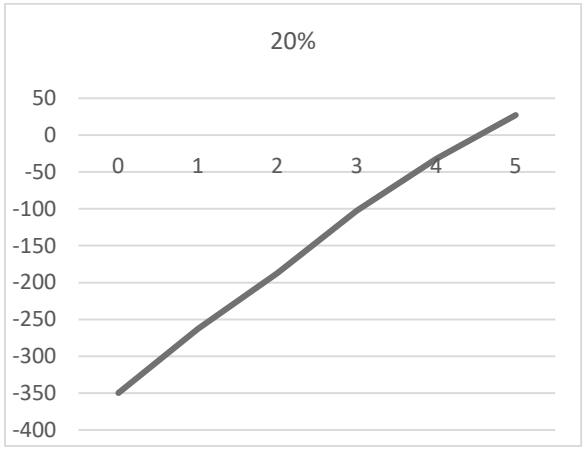


Discount After Tax for interest rate 20%

Year	0	1	2	3	4	5
Cash flow (RM)	-350	108.5	146.5	146.5	146.5	146.5
Discount factor	1	0.803	0.694	0.579	0.482	0.404
DCF	-350	87.13	75.3	84.82	70.61	59.19
Cumulative	-350	-262.87	-187.57	-102.75	-32.14	27.05

(All revenues and costs are in thousands of MYR)

Net present value(NPV)=RM 27.05
Payback Period= 4.54 Years

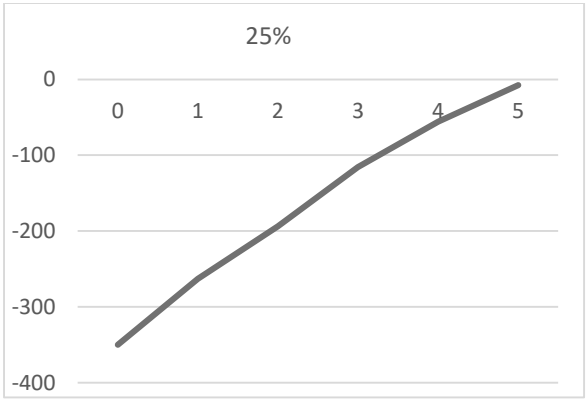


Discount After Tax for interest rate 25%

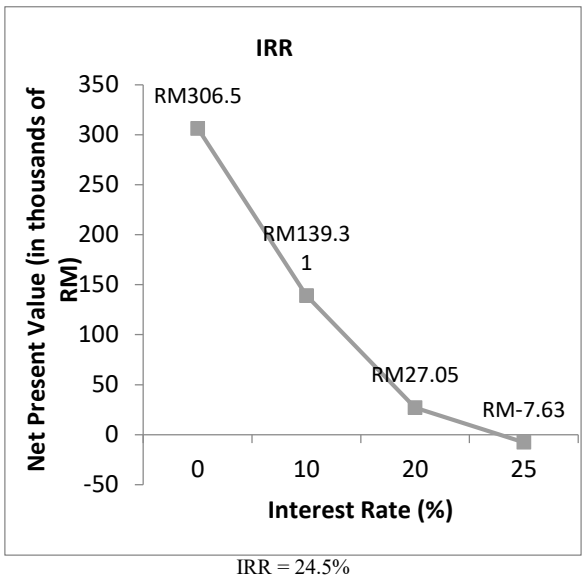
Year	0	1	2	3	4	5
Cash Flow (RM)	-350	108.5	146.5	146.5	146.5	146.5
Discount Flow	1	0.8	0.64	0.512	0.41	0.328
DCF	-350	86.8	69.44	78.01	60.08	48.05
Cumulative	-350	-263.2	-193.86	-115.75	-55.68	-7.63

(All revenues and costs are in thousands of MYR)

Net present value(NPV) = RM -7.63
Payback Period = >5 years



Internal Rate of Return (IRR)



IRR = 24.5%

Compare the Net Present Value (NPV), Payback Period (PP) and Internal Rate Return (IRR) of Project # 1 and Project # 4.

Project # 1	NET PRESENT VALUE (NPV) / DISCOUNT CASH FLOW FOR INTEREST RATE (%)	Project # 4
RM 193.85	10	RM 226.52
RM 92.25	20	RM 95.86
RM 54.60	25	RM 48.85
RM 21.45	30	RM 5.97
RM -3.70	35	RM -25.95
29.5%	*INTERNAL RATE RETURN (IRR)*	*25.3%*

Project # 1	NET PRESENT VALUE (NPV) / DISCOUNT AFTER TAX FOR INTEREST RATE (%)	Project # 4
RM 117.54	10	RM 139.31
RM 32.09	20	RM 27.05
RM 3.97	25	RM -7.63
RM -23.60	30	-
25.63%	*INTERNAL RATE RETURN (IRR)*	*24.5%*

Project # 1	PAYBACK PERIOD (PP) / DISCOUNT CASH FLOW FOR INTEREST RATE (%)	Project # 4
2.8 YEARS	10	3.15 YEARS
3.49 YEARS	20	3.73 YEARS
3.9 YEARS	25	4.13 YEARS
4.44 YEARS	30	4.91 YEARS
>5 YEARS	35	>5 YEARS

Project # 1	PAYBACK PERIOD (PP) / DISCOUNT AFTER TAX FOR INTEREST RATE (%)	Project # 4
3.34 YEARS	10	3.4 YEARS
4.25 YEARS	20	4.54 YEARS
4.96 YEARS	25	>5 YEARS
>5 YEARS	30	-

Negative NPV amounts do not imply a loss; they imply only that the proposed investment is expected to generate less than what management has decided would be the minimum acceptable return. When comparing two or more possible investments, the investment with the higher NPV is generally the better choice.

If NPV is greater than zero, accept the proposed investment because the project is expected to generate more than the company's required rate of return.

If the NPV is zero, accept the proposed investment because the project is expected to generate exactly the company's required rate of return.

If the NPV is negative, reject the proposed investment because the project is expected to generate less than the company's required rate of return.

The IRR rule is a guideline for evaluating whether to proceed with a project or investment. The IRR rule states that if the internal rate of return (IRR) on a project or an investment is greater than the minimum required rate of return, typically the cost of capital, then the project or investment should be pursued. Conversely, if the IRR on a project or investment is lower than the cost of capital, then the best course of action may be to reject it.

If the IRR is greater than the company's required rate of return, accept the proposed investment.

If the IRR is equal to the company's required rate of return, accept the proposed investment.

If the IRR is less than the company's required rate of return, reject the proposed investment.

The payback period indicates how long it will take to recover the cash investment used to acquire the asset. It is expressed in years with two decimals, such as 4.25 years. In general, shorter payback periods are more attractive because the cash is recovered in a shorter period of time. If the cash is expected to be recovered in a time period shorter than the useful life of the investment, it is tentatively deemed acceptable.

If the PP is LESS THAN 5 YEARS, accept the proposed investment.

If the PP is IN BETWEEN 5 YEARS, accept the proposed investment.

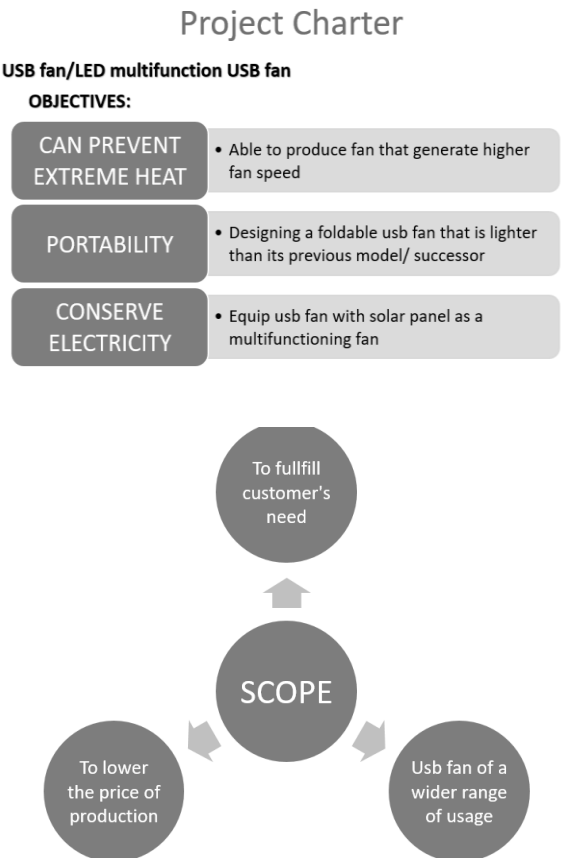
If the PP is MORE THAN 5 YEARS, reject the proposed investment.

Conclusion

In generally, example 1 is a more preferable project for a company compare with example 2. To develop a useful flashlight especially for hiking and camping purpose we will decrease the body size of flashlight, presence of zoom-in and out feature, and also change the position of switch assembly to upper side of product. Besides, the example 1 has higher net present value (NPV), shorter payback period (PP) and higher internal rate of return (IRR) compare with example 2, due to those strong point, Investment Company will more desirable to undertake example 1 as their first choice project to do investment.

3.5 USB Fan

3.5.1 Project Charter



3.5.2 Development Project Team

3.5.3 Comparison of Proposed Project

3.5.4 Project Selection

Suppose a project has the following data:

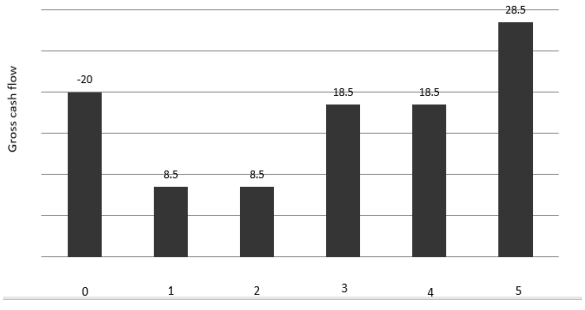
- Initial investment (I) = RM 20,000
- Annual cost of operation = RM 1500
- Planning horizon of 5 years

Expected annual revenues

- RM 10,000 for the first two years
- RM 20,000 for the third and fourth years
- RM 30,000 for the fifth years

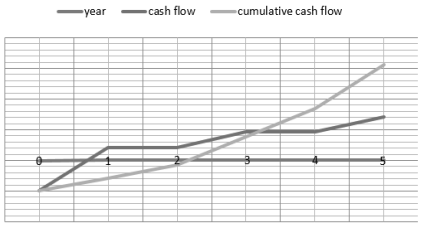
Year	0	1	2	3	4	5
Costs	-20	-1.5	-1.5	-1.5	-1.5	-1.5
Revenues		10	10	20	20	30

(All revenues and costs are in thousands of RM)



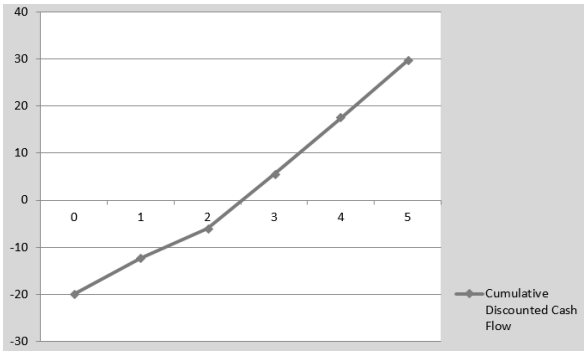
Year	0	1	2	3	4	5
Cash Flow	-20	8.5	8.5	18.5	18.5	28.5
Cumulative Cash Flow	-20	-11.5	-3.0	15.5	34.0	62.5

Undiscounted Cash Flows Before Tax



Year	0	1	2	3	4	5
Cash Flow	-20	8.5	8.5	18.5	18.5	28.5
Discount Factor	1	0.903	0.833	0.671	0.551	0.428
Discounted Cash Flow (DCF)	-20	7.6755	7.0805	12.5615	10.1935	12.198
Cumulative Discounted Cash Flow	-20	-12.3245	-5.244	7.3175	17.511	29.709

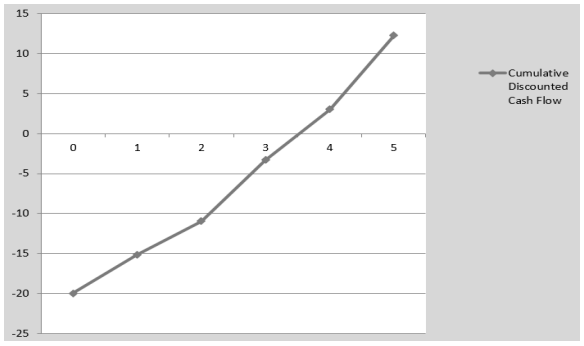
Net present value (NPV) = 29.709 (in thousands)
Payback Period = year – (Cumulative Discounted Cash Flow / Discounted Cash Flow)
= 5 – (29.709/12.198) =2.56 years



Discounted Cash Flows for Interest Rate = 20%

Year	0	1	2	3	4	5
Cash Flow	-20	8.5	8.5	18.5	18.5	28.5
Discount Factor	1	0.572	0.491	0.435	0.359	0.301
Discounted Cash Flow (DCF)	-20	4.862	4.1735	8.0475	6.6415	8.5785
Cumulative Discounted Cash Flow	-20	-15.138	-10.9645	-2.917	3.7245	12.303

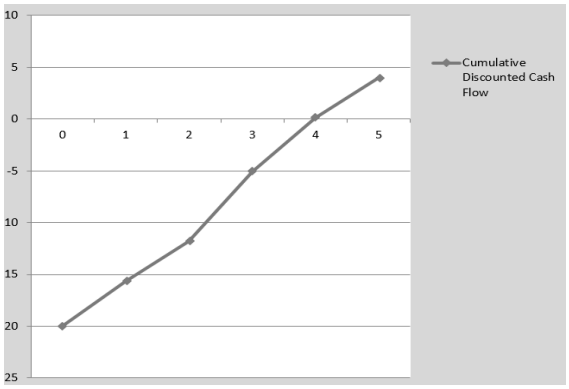
Net present value (NPV) = 12.303 (in thousands)
Payback Period = year – (Cumulative Discounted Cash Flow / Discounted Cash Flow)
= 5 – (12.303/8.5785) =3.57 years



Discounted Cash Flows for Interest Rate = 25%

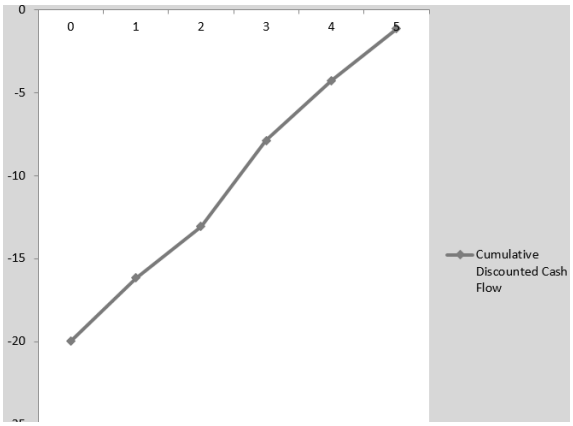
Year	0	1	2	3	4	5
Cash Flow	-20	8.5	8.5	18.5	18.5	28.5
Discount Factor	1	0.513	0.451	0.365	0.281	0.134
Discounted Cash Flow (DCF)	-20	4.3605	3.8335	6.7525	5.1985	3.819
Cumulative Discounted Cash Flow	-20	-15.6395	-11.806	-5.0535	0.145	3.964

Net present value (NPV = 3.964 (in thousands)
Payback Period = year – (Cumulative Discounted Cash Flow / Discounted Cash Flow)
= 5 – (3.964/3.819) =3.96 years

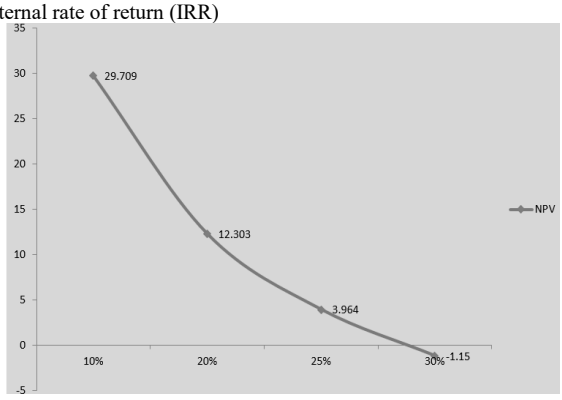


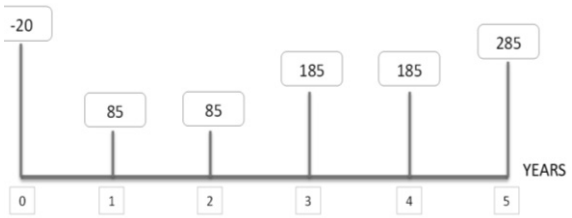
Year	0	1	2	3	4	5
Cash Flow	-20	8.5	8.5	18.5	18.5	28.5
Discount Factor	1	0.450	0.365	0.28	0.195	0.11
Discounted Cash Flow (DCF)	-20	3.825	3.1025	5.18	3.6075	3.135
Cumulative Discounted Cash Flow	-20	-16.175	-13.0725	-7.8925	-4.285	-1.15

Net present value (NPV) = -11.5 (in thousands)
Payback Period = year – (Cumulative Discounted Cash Flow / Discounted Cash Flow)
= 5 – (-11.5/ 31.35) =5.367 years



Internal rate of return (IRR)





STRAIGHT LINE	4	4	4	4	4
SUM OF DIGIT	20(5/15) =6.67	20(4/15) =5.33	20(3/15) =4	20(2/15) =2.67	20(1/15) =1.33
DECLINING BALANCE	20(0.3) =6	20(0.09) =1.8	20(0.027) =0.54	20(0.0081) =0.162	20(0.000243) =0.00486

YEAR			1	2	3	4	5
CASH FLOW	a		8.5	8.5	18.5	18.5	28.5
DEPRECIATION	b		4	4	4	4	4
TAXABLE INCOME	c	a - b	4.5	4.5	14.5	14.5	24.5
TAX (30%)	d	Tax * c	1.35	1.35	4.35	4.35	7.35
AFTER TAX CASH FLOW	e	a - d	7.15	7.15	14.15	14.15	21.15

UNDISCOUNTED AFTER TAX CASH FLOW

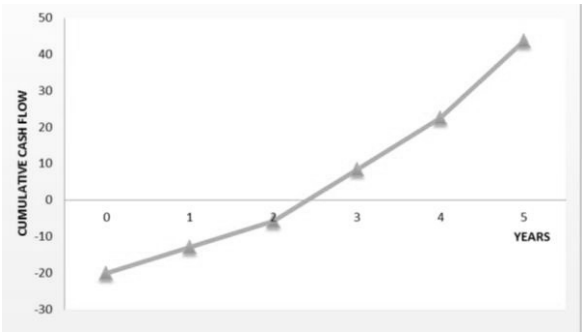
YEAR	0	1	2	3	4	5
AFTER TAX CASH FLOW	-20	7.15	7.15	14.15	14.15	21.15
CUMULATIVE CASH FLOW	-20	-12.85	-5.7	8.45	22.6	43.75

- **NET PRESENT VALUE (NPV)** = 43.75 (IN THOUSANDS)
- **PAYBACK PERIOD** = 2.43 YEARS

AFTER TAX DISCOUNTED CASH FLOWS FOR INTEREST RATE = 10%

YEAR	0	1	2	3	4	5
AFTER TAX CASH FLOW	-20	7.15	7.15	14.15	14.15	21.15
DISCOUNT FACTOR	1	0.909	0.826	0.751	0.683	0.621
DISCOUNTED CASH FLOW (DCF)	-20	6.49	5.90	10.62	9.66	13.13
CUMULATIVE DISCOUNTED CASH FLOW	-20	-13.50	-7.59	3.03	12.69	25.83

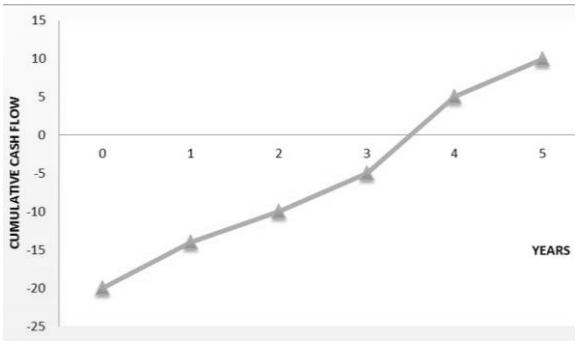
- **NET PRESENT VALUE (NPV)** = 25.83 (IN THOUSANDS)
- **PAYBACK PERIOD** = 2.97 YEARS



AFTER TAX DISCOUNTED CASH FLOWS FOR INTEREST RATE = 20%

YEAR	0	1	2	3	4	5
AFTER TAX CASH FLOW	-20	7.15	7.15	14.15	14.15	21.15
DISCOUNT FACTOR	1	0.833	0.694	0.579	0.482	0.402
DISCOUNTED CASH FLOW (DCF)	-20	5.95	4.96	8.19	6.82	8.50
CUMULATIVE DISCOUNTED CASH FLOW	-20	-14.04	-9.08	-0.88	5.93	14.43

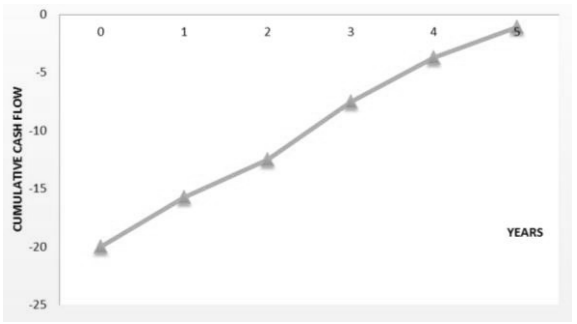
- **NET PRESENT VALUE (NPV)** = 14.43 (IN THOUSANDS)
- **PAYBACK PERIOD** = 3.5 YEARS

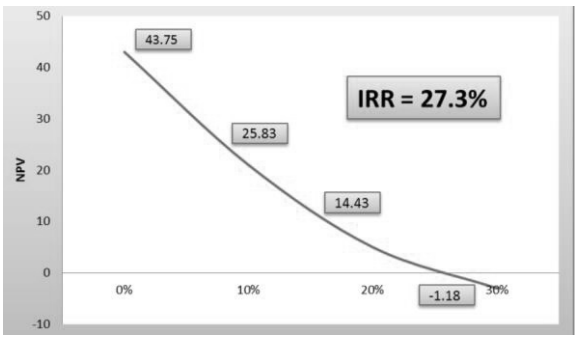


AFTER TAX DISCOUNTED CASH FLOWS FOR INTEREST RATE = 30%

YEAR	0	1	2	3	4	5
AFTER TAX CASH FLOW	-20	7.15	7.15	14.15	14.15	21.15
DISCOUNT FACTOR	1	0.592	0.445	0.350	0.269	0.122
DISCOUNTED CASH FLOW (DCF)	-20	4.29	3.18	4.95	3.80	2.58
CUMULATIVE DISCOUNTED CASH FLOW	-20	-15.70	-12.52	-7.57	-3.76	-1.18

- **NET PRESENT VALUE (NPV)** = -1.18 (IN THOUSANDS)
- **PAYBACK PERIOD** = > 5 YEARS





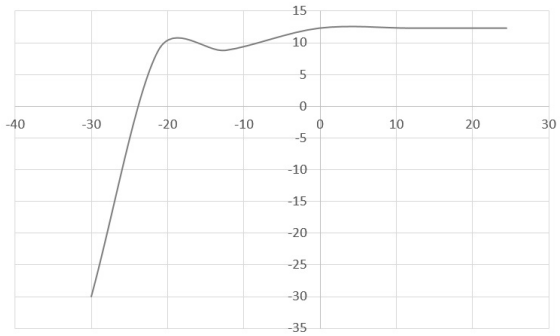
Computation of After Tax Cash Flows

Year			1	2	3	4	5
Cash Flow	a		10	10	15	15	15
Depreciation	b		6	6	6	6	6
Taxable Income	c	a – b	4	4	9	9	9
Tax (30%)	d	tax * c	1.2	1.2	2.7	2.7	2.7
After Tax Cash Flow	e	a – d	8.8	8.8	12.3	12.3	12.3

Undiscounted After Tax Cash Flows

Year	0	1	2	3	4	5
After Tax Cash Flow	-30	8.8	8.8	12.3	12.3	12.3
Cumulative Cash Flow	-30	-21.2	-12.4	-0.1	12.2	24.5

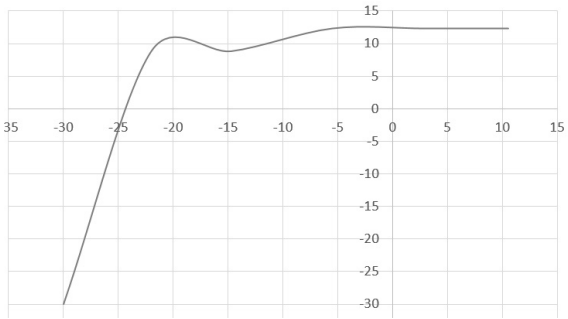
- Net present value (NPV) = 24.5 (in thousands)
- Payback Period = 3.01 years



After Tax Discounted Cash Flows for Interest Rate = 10%

Year	0	1	2	3	4	5
After Tax Cash Flow	-30	8.8	8.8	12.3	12.3	12.3
Discount Factor	1	0.909	0.826	0.751	0.683	0.621
Discounted Cash Flow (DCF)	-30	8.00	7.27	9.24	8.40	7.64
Cumulative Discounted Cash Flow	-30	-22	-14.73	-5.49	2.91	10.55

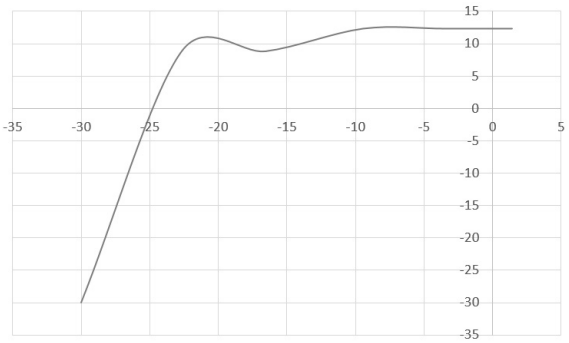
- Net present value (NPV) = 10.55 (in thousands)
- Payback Period = 3.78 years



After Tax Discounted Cash Flows for Interest Rate = 20%

Year	0	1	2	3	4	5
After Tax Cash Flow	-30	8.8	8.8	12.3	12.3	12.3
Discount Factor	1	0.833	0.694	0.579	0.482	0.402
Discounted Cash Flow (DCF)	-30	7.33	6.11	7.12	5.93	4.94
Cumulative Discounted Cash Flow	-30	-22.67	-16.56	-9.44	-3.51	1.43

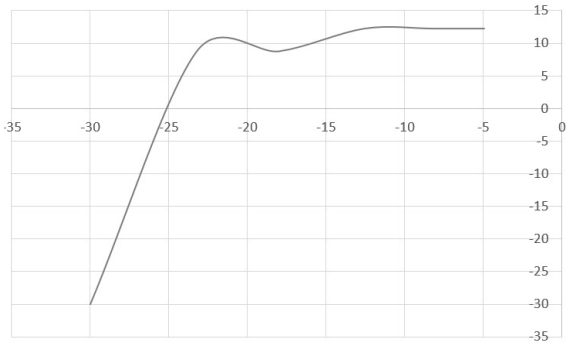
- Net present value (NPV) = 1.43(in thousands)
- Payback Period = 4.6 years

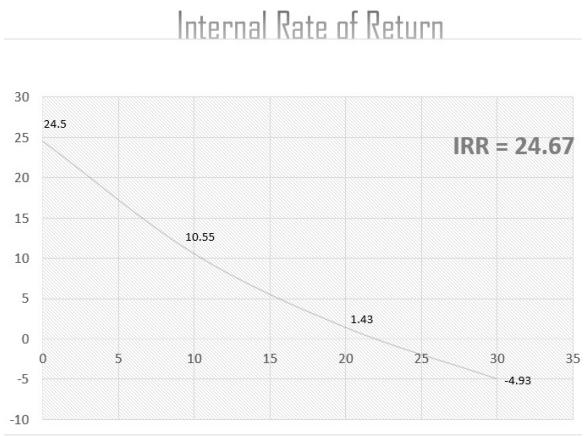


After Tax Discounted Cash Flows for Interest Rate = 30%

Year	0	1	2	3	4	5
After Tax Cash Flow	-30	8.8	8.8	12.3	12.3	12.3
Discount Factor	1	0.769	0.592	0.445	0.350	0.269
Discounted Cash Flow (DCF)	-30	6.77	5.21	5.47	4.31	3.31
Cumulative Discounted Cash Flow	-30	-23.23	-18.02	-12.55	-8.24	-4.93

- Net present value (NPV) = -4.93 (in thousands)
- Payback Period = > 5 years





Comparison between normal usb and led multifunction usb

Normal USB		Multifunction LED USB
29,000(10% interest)	**NPV**	18,000 (10% interest)
2.67 years	**PP**	3.20years
27.7%	**IRR**	30%

Conclusion

- **Normal usb fan shows a higher NPV (reference to 10% interest rate without tax) than multifunction led usb which indicates that the company is having more inflow cash from normal usb than the led usb.**
- **Shorter pay back period attracts investor which shows in the comparison table where normal usb have a shorter payback period than multifunction.**
- **LED usb fan has a higher IRR than normal usb which indicates that the LED usb is more profitable than normal usb, but their differences is not very big (around 3%). Moreover, lower IRR might be meaning that the project is a longer project with a slowly and steady earning returns, normal usb might able to overtake LED usb as a more profitable project over a longer period of time.**

3.6 Thermos Flask

3.6.1 Project Charter

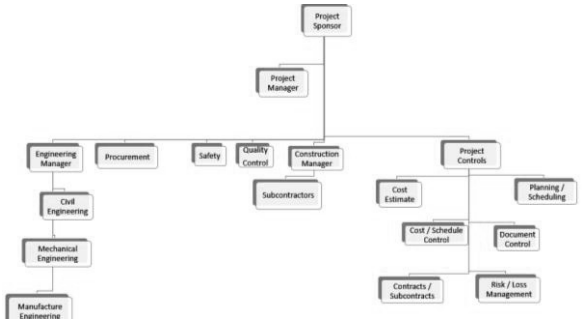
Objective

- To improve the material of thermos bottle for increase the thermos bottle heat holding time
- To improve the design of thermos bottle to bounce cap thermos and easy to use

Scope

- Target Customer : Teenagers, Office Worker and Coffee Lovers
- Price to be sold : RM60~RM80
- Material : Metal and Styrofoam
- Insulation Time : 10~12 hours
- Cap Type : Bounce Cap

3.6.2 Development Project Team



3.6.3 Comparison of Proposed Project

Scale of Evaluation

	Very Poor	Poor	Fair	Average	Good	Excellent	
	0	1	2	3	4	5	
Low	Attractiveness						High
High	Cost						Low
Difficult	Feasibility						Easy
Long	Time						Short

Scoring of Alternative Project

No	Alternative Project	A	B	C	D	Total Score
1	Multi-function	5	3	4	2	16
2	Colourful & Festival Design	5	4	5	4	18
3	Different Size	5	3	4	3	15
4	Engraving Name	5	3	3	4	12
5	Change Twist-off Cap to Bounce Cap	5	4	5	4	18
6	Increase Insulation Time	5	3	5	2	15

A = Attractiveness
B = Cost
C = Feasibility
D = Time

Result of Screening

- Project 1 : Multi function 16 marks
- Project 2 : Colourful & Festival Design 18 marks
- Project 5 : Change twist-of cap to bounce cap 18 marks

Selected Project

- Project 2 : Colourful & Festival Design
- Project 5 : Change twist-off cap to bounce cap

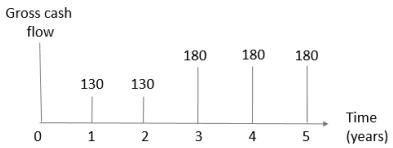
3.6.4 Project Selection

Project 2 : Colourful & Festival Design

The data of the project
- Initial investment (I) = RM400,000
- Annual cost of operation = RM20,000
- Planning horizon of 5 years

Expected annual revenues
- RM150,000 for the first two years
- RM 200,000 for the next three years

Year	0	1	2	3	4	5
Costs (RM k)	-400	-20	-20	-20	-20	-20
Revenue (RM k)		150	150	200	200	200

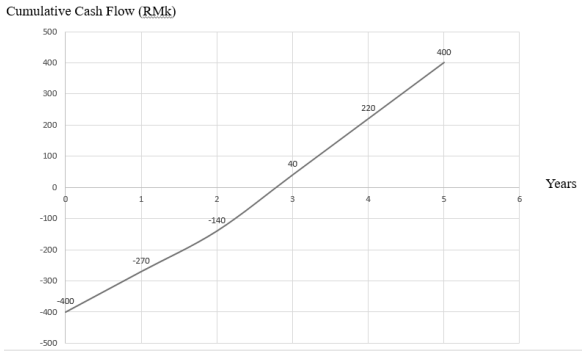


Undiscounted Cash Flows Before Tax

Year	0	1	2	3	4	5
Cash Flow	-400	130	130	180	180	180
Cumulative Cash Flow	-400	-270	-140	40	220	400

- Net present value (NPV) = 400(RM k)
- Payback period = 2.78 years

The graph of undiscounted cash flow before tax

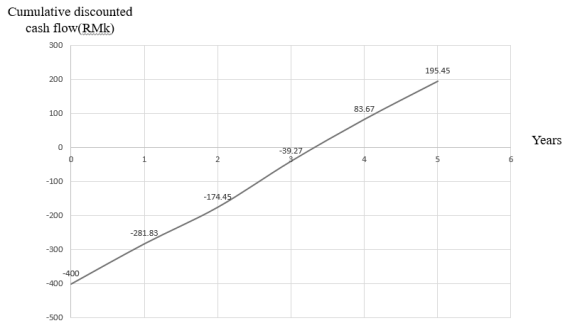


Discounted Cash Flows for Interest Rate = 10%

Year	0	1	2	3	4	5
Cash Flow	-400	130	130	180	180	180
Discount Factor	1	0.909	0.826	0.751	0.683	0.621
Discounted Cash Flow (DCF)	-400	118.17	107.38	135.18	122.94	111.78
Cumulative Discounted Cash Flow	-400	-281.83	-174.45	-39.27	83.67	195.45

- Net present value (NPV) = 195.45(RM k)
- Payback period = 3.22 years

The graph of discounted cash flow for interest rate = 10%

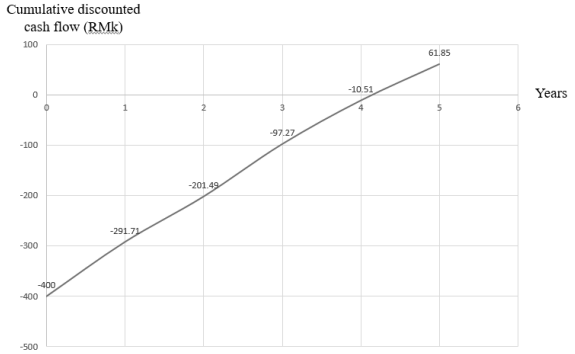


Discounted Cash Flows for Interest Rate = 20%

Year	0	1	2	3	4	5
Cash Flow	-400	130	130	180	180	180
Discount Factor	1	0.833	0.694	0.579	0.482	0.402
Discounted Cash Flow (DCF)	-400	108.29	90.22	104.22	86.76	72.36
Cumulative Discounted Cash Flow	-400	-291.71	-201.49	-97.27	-10.51	61.85

- Net present value (NPV) = 61.85(RM k)
- Payback period = 4.06 years

The graph of discounted cash flow for interest rate = 20%

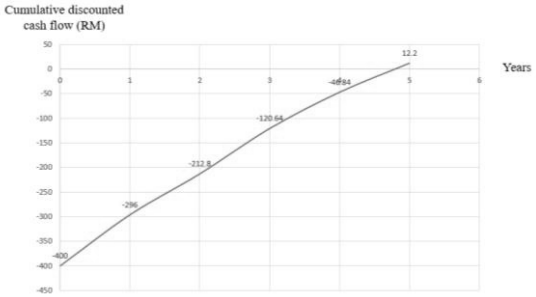


Discounted Cash Flows for Interest Rate = 25%

Year	0	1	2	3	4	5
Cash Flow	-400	130	130	180	180	180
Discount Factor	1	0.800	0.640	0.512	0.410	0.328
Discounted Cash Flow (DCF)	-400	104	83.2	92.16	73.8	59.04
Cumulative Discounted Cash Flow	-400	-296	-212.80	-120.64	-46.84	12.2

- Net present value (NPV) = 12.20(RM k)
- Payback period = 4.26 years

The graph of discounted cash flow for interest rate = 25% against the year

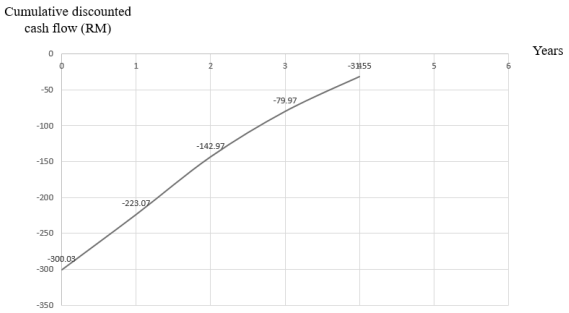


Discounted Cash Flows for Interest Rate = 30%

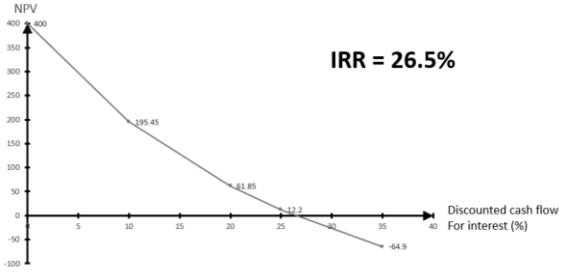
Year	0	1	2	3	4	5
Cash Flow	-400	130	130	180	180	180
Discount Factor	1	0.769	0.592	0.445	0.350	0.269
Discounted Cash Flow (DCF)	-400	99.97	76.96	80.10	63.00	48.42
Cumulative Discounted Cash Flow	-400	-300.03	-223.07	-142.97	-79.97	-31.55

- Net present value (NPV) = -31.55(RM k)
- Payback period = > 5 years

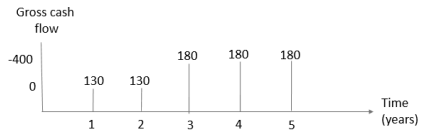
The graph of discounted cash flow for interest rate = 30%



Internal Rate Of Return (IRR)



Cash Flow



Depreciation

Straight Line	60	60	60	60	60
Sum of digit	400(5/15) =133.33	400(4/15) =106.67	400(3/15) =80	400(2/15) =53.33	400(1/15) =26.67
Declining Balance	400(0.3) =120	400(0.09) =36	400(0.027) =10.8	400(0.0081) =3.24	400(0.000243) =0.0972

Computation of After Tax Cash Flows

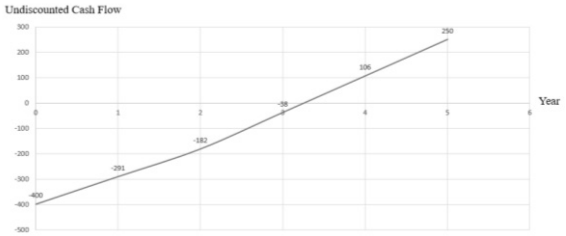
Year			1	2	3	4	5
Cash Flow	a		130	130	180	180	180
Depreciation	b		60	60	60	60	60
Taxable Income	c	a – b	70	70	120	120	120
Tax (30%)	d	tax * c	21	21	36	36	36
After Tax Cash Flow	e	a – d	109	109	144	144	144

Undiscounted Cash Flows After Tax

Year	0	1	2	3	4	5
Cash Flow	-400	109	109	144	144	144
Cumulative Cash Flow	-400	-291	-182	-38	106	250

- Net present value (NPV) = 250(RM k)
- Payback period = 3.26 years

The graph of Undiscounted Cash Flow against Year

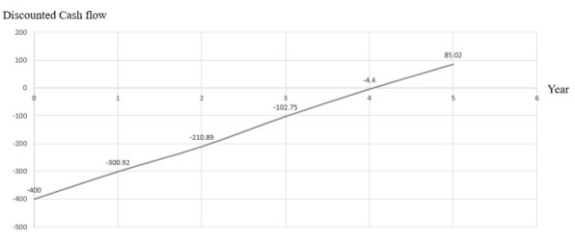


After Tax Discounted Cash Flows for Interest Rate = 10%

Year	0	1	2	3	4	5
Cash Flow	-400	109	109	144	144	144
Discount Factor	1	0.909	0.826	0.751	0.683	0.621
Discounted Cash Flow (DCF)	-400	99.08	90.03	108.14	98.35	89.42
Cumulative Discounted Cash Flow	-400	-300.92	-210.89	-102.75	-4.40	85.02

- Net present value (NPV) = 85.02(RM k)
- Payback period = 4.03 years

The Graph of Discounted Cash flow against Year

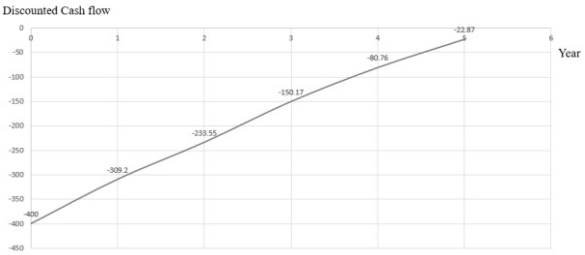


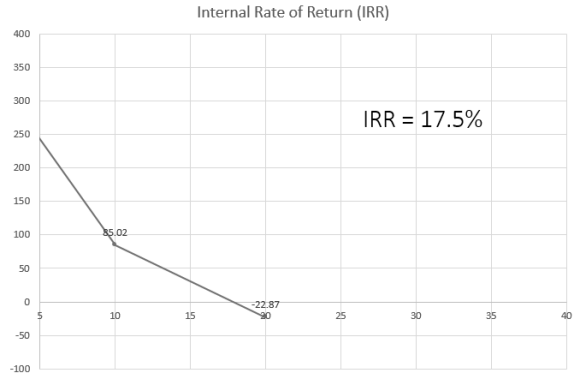
After Tax Discounted Cash Flows for Interest Rate = 20%

Year	0	1	2	3	4	5
Cash Flow	-400	109	109	144	144	144
Discount Factor	1	0.833	0.694	0.579	0.482	0.402
Discounted Cash Flow (DCF)	-400	90.80	75.65	83.38	69.41	57.89
Cumulative Discounted Cash Flow	-400	-309.20	-233.55	-150.17	-80.76	-22.87

- Net present value (NPV) = -22.87(RM k)
- Payback period = > 5 years

The Graph of Discounted Cash flow against Year



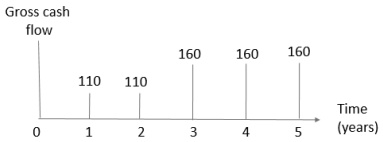


Project 5 : Change twist-off cap to bounce cap

The data of the project
- Initial investment (I) = RM400,000
- Annual cost of operation = RM40,000
- Planning horizon of 5 years

Expected annual revenues
- RM150,000 for the first two years
- RM 200,000 for the next three years

Year	0	1	2	3	4	5
Costs (RM k)	-400	-40	-40	-40	-40	-40
Revenue (RM k)		150	150	200	200	200

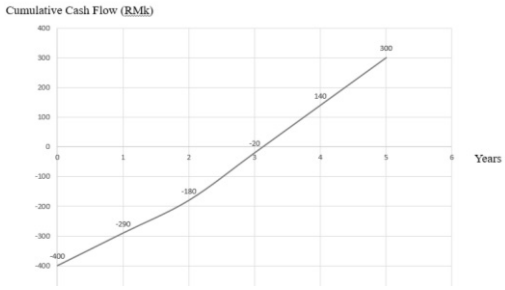


Undiscounted Cash Flows Before Tax

Year	0	1	2	3	4	5
Cash Flow	-400	110	110	160	160	160
Cumulative Cash Flow	-400	-290	-180	-20	140	300

- Net present value (NPV) = 300(RM k)
- Payback period = 3.13 years

The graph of undiscounted cash flow before tax

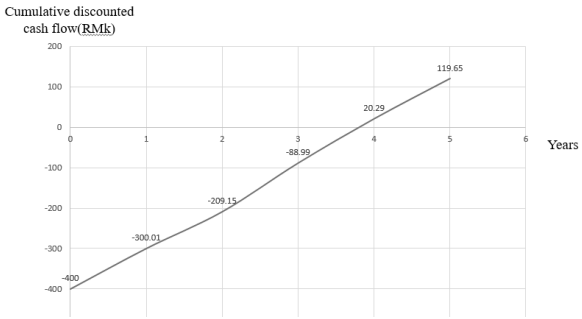


Discounted Cash Flows for Interest Rate = 10%

Year	0	1	2	3	4	5
Cash Flow	-400	110	110	160	160	160
Discount Factor	1	0.909	0.826	0.751	0.683	0.621
Discounted Cash Flow (DCF)	-400	99.99	90.86	120.16	109.28	99.36
Cumulative Discounted Cash Flow	-400	-300.01	-209.15	-88.99	20.29	119.65

- Net present value (NPV) = 119.65(RM k)
- Payback period = 3.81 years

The graph of discounted cash flow for interest rate = 10%

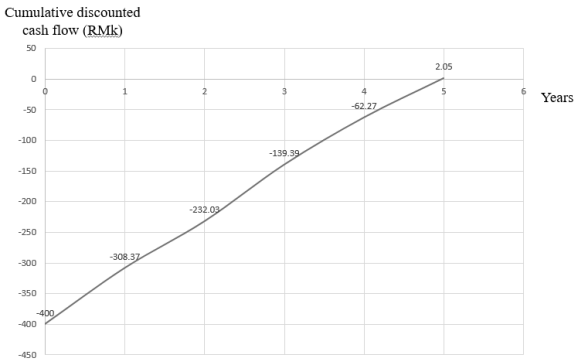


Discounted Cash Flows for Interest Rate = 20%

Year	0	1	2	3	4	5
Cash Flow	-400	110	110	160	160	160
Discount Factor	1	0.833	0.694	0.579	0.482	0.402
Discounted Cash Flow (DCF)	-400	91.63	76.34	92.64	77.12	64.32
Cumulative Discounted Cash Flow	-400	-308.37	-232.03	-139.39	-62.27	2.05

- Net present value (NPV) = 2.05(RM k)
- Payback period = 4.97 years

The graph of discounted cash flow for interest rate = 20%

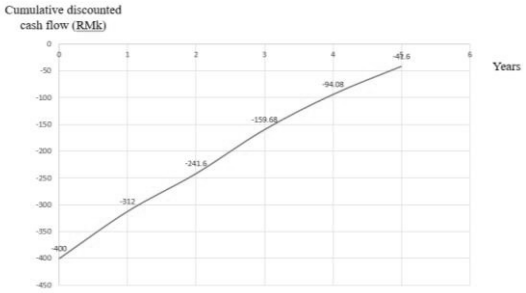


Discounted Cash Flows for Interest Rate = 25%

Year	0	1	2	3	4	5
Cash Flow	-400	110	110	160	160	160
Discount Factor	1	0.800	0.640	0.512	0.410	0.328
Discounted Cash Flow (DCF)	-400	88	70.4	81.92	65.6	52.48
Cumulative Discounted Cash Flow	-400	-312	-241.6	-159.68	-94.08	-41.6

- Net present value (NPV) = -41.6(RM k)
- Payback period = >5 years

The graph of discounted cash flow for interest rate = 25% against the year

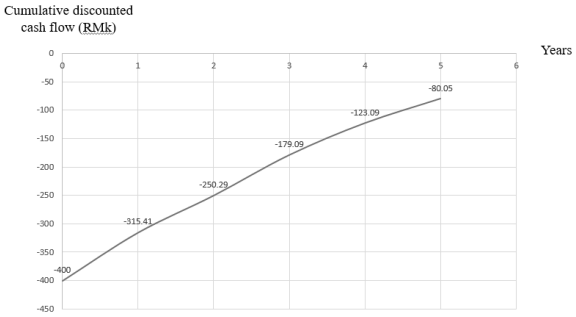


Discounted Cash Flows for Interest Rate = 30%

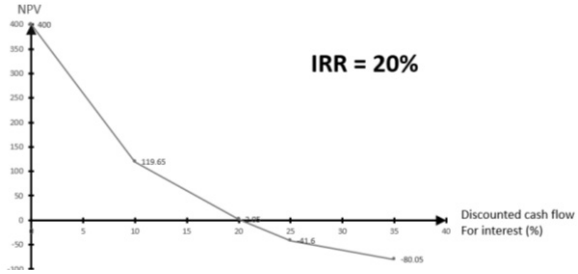
Year	0	1	2	3	4	5
Cash Flow	-400	110	110	160	160	160
Discount Factor	1	0.769	0.592	0.445	0.350	0.269
Discounted Cash Flow (DCF)	-400	84.59	65.12	71.2	56	43.04
Cumulative Discounted Cash Flow	-400	-315.41	-250.29	-179.09	-123.09	-80.05

- Net present value (NPV) = -80.05(RM k)
- Payback period = > 5 years

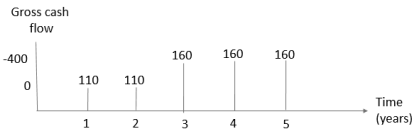
The graph of discounted cash flow for interest rate = 30%



Internal Rate Of Return (IRR)



Cash Flow



Depreciation

Straight Line	60	60	60	60	60
Sum of digit	400(5/15) =133.33	400(4/15) =106.67	400(3/15) =80	400(2/15) =53.33	400(1/15) =26.67
Declining Balance	400(0.3) =120	400(0.09) =36	400(0.027) =10.8	400(0.0081) =3.24	400(0.000243) =0.0972

Computation of After Tax Cash Flows

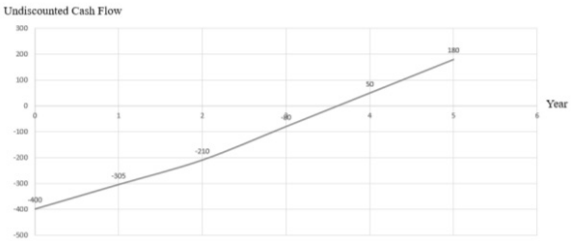
Year			1	2	3	4	5
Cash Flow	a		110	110	160	160	160
Depreciation	b		60	60	60	60	60
Taxable Income	c	a – b	50	50	100	100	100
Tax (30%)	d	tax * c	15	15	30	30	30
After Tax Cash Flow	e	a – d	95	95	130	130	130

Undiscounted Cash Flows After Tax

Year	0	1	2	3	4	5
Cash Flow	-400	95	95	130	130	130
Cumulative Cash Flow	-400	-305	-210	-80	50	180

- Net present value (NPV) = 180(RM k)
- Payback period = 3.26 years

The graph of Undiscounted Cash Flow against Year

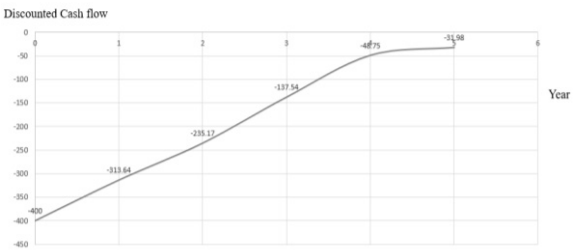


After Tax Discounted Cash Flows for Interest Rate = 10%

Year	0	1	2	3	4	5
Cash Flow	-400	95	95	130	130	130
Discount Factor	1	0.909	0.826	0.751	0.683	0.621
Discounted Cash Flow (DCF)	-400	86.36	78.47	97.63	88.79	80.73
Cumulative Discounted Cash Flow	-400	-313.64	-235.17	-137.54	-48.75	31.98

- Net present value (NPV) = 31.98(RM k)
- Payback period = 4.6 years

The Graph of Discounted Cash flow against Year

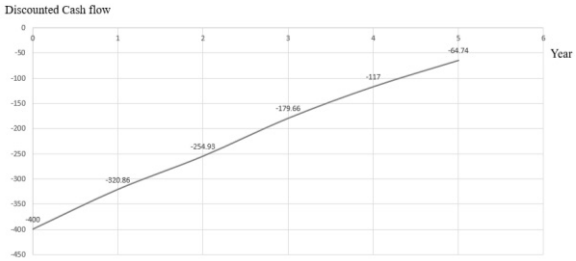


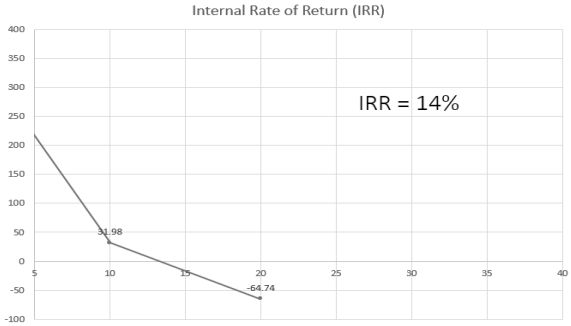
After Tax Discounted Cash Flows for Interest Rate = 20%

Year	0	1	2	3	4	5
Cash Flow	-400	95	95	130	130	130
Discount Factor	1	0.833	0.694	0.579	0.482	0.402
Discounted Cash Flow (DCF)	-400	79.14	65.93	75.27	62.66	52.26
Cumulative Discounted Cash Flow	-400	-320.86	-254.93	-179.66	-117	-64.74

- Net present value (NPV) = -64.74(RM k)
- Payback period = > 5 years

The Graph of Discounted Cash flow against Year





Conclusion

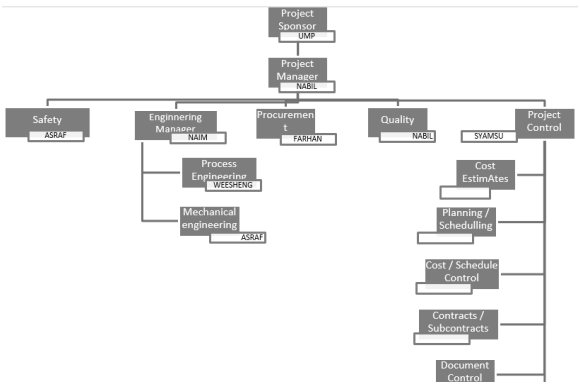
After compare 2 projects, we decide to select Project 2 (Colourful & Festival Design). The reason we choose Project 2 is because the Net present value (NPV) of Project 2 is higher than Project 5 and Payback Period is shorter than Project 5.

3.7 Portable Fan

3.7.1 Project Charter

Objective:
To develop multifunction fan
Scope:
1) Target customer: Student / Labor
2) Price to be sold: RM30 – RM45
3) Material: Plastic
4) Proses concern: Molding

3.7.2 Development Project Team



3.7.3 Comparison of Proposed Project

To develop a portable fan

- Multifunction
- Hidden wire
- Colorful
- Speed Adjustable
- Battery warning

Scale of Evaluation

	Very poor	Poor	Fair	Average	Good	Excellent	
	0	1	2	3	4	5	
Low	Attractiveness						high
High	Cost						Low
difficult	Feasibility						easy
Long	Time						short

Scoring of Alternate Project

No	Alternative Project	A	B	C	D	Total Score
1	Multi – Function	5	2	3	2	12
2	Hidden wire	5	5	4	4	18
3	Colorful	4	3	2	3	12
4	Speed adjustable	4	5	3	2	14
5	Battery warning	5	4	3	3	15

Result of Screening:
Project # 2 Hidden Wire = 18 points
Project # 5 Battery warning = 15 points
Project # 4 Speed Adjustable = 14 points

3.7.4 Project Selection

Undiscounted Cash Flows Before Tax

Sample project 1		Sample project 2
RM650 000 LOWER	Net Present Value (NPV)	RM1 250 000 HIGHER
2.63 year LONGER	Payback Period (PP)	2.45 year SHORTER

Sample project 2 is better than sample project 1 due to the higher Net Present Value (NPV) and shorter Payback Period (PP).

Discounted Cash Flow for Interest Rate of 10%

Sample project 1		Sample project 2
RM350 500 LOWER	Net Present Value (NPV)	RM 709 700 HIGHER
3.14 year LONGER	Payback Period (PP)	2.81 year SHORTER

Sample project 2 is better than sample project 1 due to the higher Net Present Value (NPV) and shorter Payback Period (PP).

Discounted Cash Flow for Interest rate of 20%

Sample project 1		Sample project 2
RM156 500 LOWER	Net Present Value (NPV)	RM359 700 HIGHER
3.71 year LONGER	Payback Period (PP)	3.31 year SHORTER

Sample project 2 is better than sample project 1 due to the higher Net Present Value (NPV) and shorter Payback Period (PP).

Discounted Cash Flow for Interest Rate of 25%

Sample project 1		Sample project 2
RM82 900 LOWER	Net Present Value (NPV)	RM230 100 HIGHER
4.13 year LONGER	Payback Period (PP)	3.65 year SHORTER

Sample project 2 is better than sample project 1 due to the higher Net Present Value (NPV) and shorter Payback Period (PP).

Discounted Cash Flow for Interest Rate of 30%

Sample project 1		Sample project 2
RM22 650 LOWER	Net Present Value (NPV)	RM116 050 HIGHER
4.71 year LONGER	Payback Period (PP)	4.12 year SHORTER

Sample project 2 is better than sample project 1 due to the higher Net Present Value (NPV) and shorter Payback Period (PP).

IRR Undiscounted Cash Flows Before Tax

Sample project 1	Sample project 2
32.00% LOWER	35.50% HIGHER

Sample 2 is better than sample project 1 due to the higher IRR that is affected by the higher NPV.

Undiscounted After Tax Cash Flows

Sample project 1		Sample project 2
RM455 000 LOWER	Net Present Value (NPV)	RM875 000 HIGHER
3.05 year LONGER	Payback Period (PP)	2.75 year SHORTER

Sample project 2 is better than sample project 1 due to the higher Net Present Value (NPV) and shorter Payback Period (PP).

After Tax Discounted Cash Flows for Interest Rate=10%

Sample project 1		Sample project 2
RM209 050 LOWER	Net Present Value (NPV)	RM439 290 HIGHER
3.60 year LONGER	Payback Period (PP)	3.26 year SHORTER

Sample project 2 is better than sample project 1 due to the higher Net Present Value (NPV) and shorter Payback Period (PP).

After Tax Discounted Cash Flows for Interest Rate=20%

Sample project 1		Sample project 2
RM49 260 LOWER	Net Present Value (NPV)	RM155 300 HIGHER
4.47 year LONGER	Payback Period (PP)	4.01 year SHORTER

Sample project 2 is better than sample project 1 due to the higher Net Present Value (NPV) and shorter Payback Period (PP).

After Tax Discounted Cash Flows for Interest Rate=30%

Sample project 1		Sample project 2
-RM61 380 LOWER	Net Present Value (NPV)	-RM43 260 HIGHER
>5 year	Payback Period (PP)	>5 year

Sample project 2 is better than sample project 1 due to the higher Net Present Value (NPV).

IRR Undiscounted Cash Flows After Tax

Sample project 1	Sample project 2
25.00% LOWER	28.00% HIGHER

Conclusion
Sample 2 is better than sample project 1 due to the higher IRR that is affected by the higher NPV.

3.8 Cupboard

3.8.1 Project Charter

Objective:
Enhancing features of our "US Cupboards" to meet current customer and market requirements.

Scope:
Made of "Teak Wood" and "Stainless Steel" components. Targeted for high - end moderate spending customers. Priced at RM1899. Project estimated to be completed in 28 days. All components must be assembled and completely refined within 28 days.

3.8.2 Development Project Team

Project Role	Responsibilities	Assigned to
[Project Manager]	Supervising the project ensuring milestones are completed within allocated time.	Mr. Wan
[Business Analyst]	Surveying the market for customer requirements & competitor products for comparison purposes.	Mrs. Lim
[Supervisors]	Supervising labor workers to ensure maximum performance and monitoring use of resources.	Mr. Kalai Mr. Lok
[QC Committee]	Ensuring details of finished product is up to scope & specification.	QC Department
[Procurement]	Procuring raw materials and managing material resource inventory	Logistics Department

3.8.3 Comparison of Proposed Project

Criteria need to be compared:
- Focus on weight and durable materials (I).
- Replacing minor components with plastic (II).
- Adding lighting elements (III).
- Increase wideness of cupboard space (IV).
- Adding "slick" design features (V).
- Increasing height of cupboard (VI).

Proposed Projects	Allure 1-Not Attractive 5- Alluring	Cost 1-Costly 5-Low Cost	Value 1- Low 5- High
I	4	3	5
II	1	5	2
III	5	2	3
IV	4	3	4
V	5	1	3
VI	3	3	3

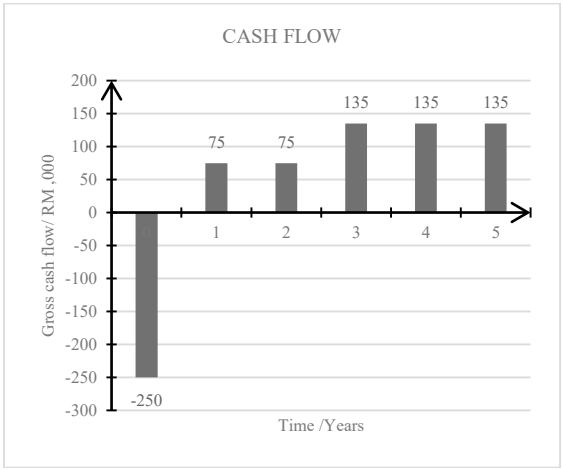
Result:
I - 12 points
II - 8 points
III - 10 points
IV - 11 points
V - 9 points
VI - 9 points

3.8.4 Project Selection

Project I: Focus On Weight and Durable Materials.
The data of the project:
- Initial investment (I) = RM 250,000
- Annual cost of operation = RM 15,000
- Planning horizon of 5 years

Expected annual revenues
- RM 90,000 for the first two years
- RM 150,000 for the next three years

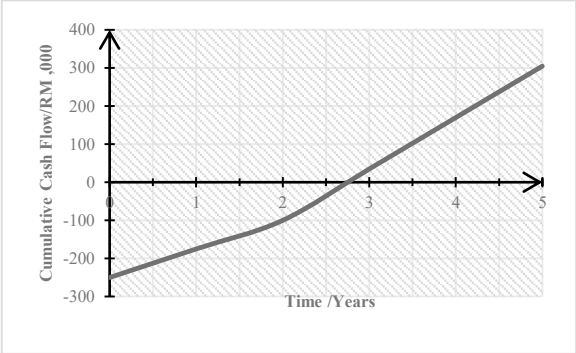
Year	0	1	2	3	4	5
Costs	-250k	-15k	-15k	-15k	-15k	-15k
Revenues		90k	90k	150k	150k	150k
Cash Flow	-250k	75k	75k	135k	135k	135k



Undiscounted Cash Flows Before Tax

Year	0	1	2	3	4	5
Cash Flow	-250k	75k	75k	135k	135k	135k
Cumulative Cash Flow	-250k	-175k	-100k	35k	170k	305k

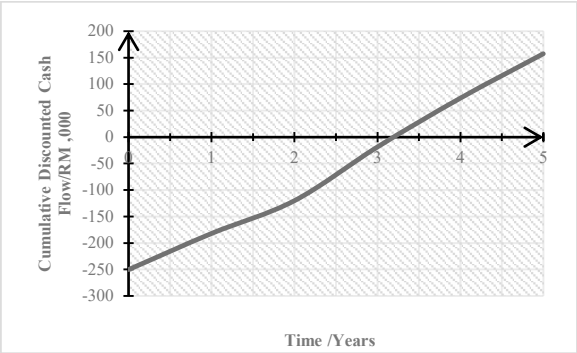
Net present value(NPV) = 305k
Payback Period = 2.73 years



Discounted Cash Flows for Interest Rate = 10%

Year	0	1	2	3	4	5
Cash Flow	-250k	75k	75k	135k	135k	135k
Discount Factor	1	0.909	0.826	0.751	0.683	0.621
Discounted Cash Flow (DCF)	-250k	68.18k	61.95k	101.39	92.21k	83.84k
Cumulative Discounted Cash Flow	-250k	-181.82k	-119.87k	-18.48k	73.73k	157.57k

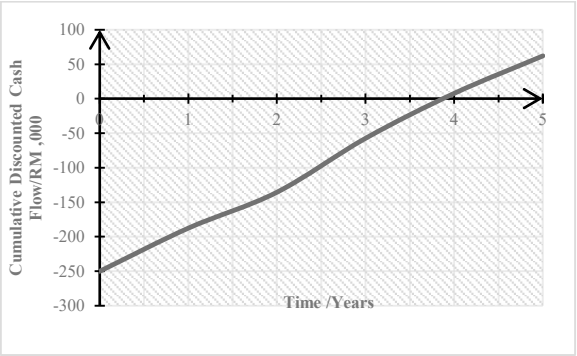
Net Present value (NPV) = 155.57k
Payback Period = 3.23 years



Discounted Cash Flows for Interest Rate = 20%

Year	0	1	2	3	4	5
Cash Flow	-250k	75k	75k	135k	135k	135k
Discount Factor	1	0.833	0.694	0.579	0.482	0.402
Discounted Cash Flow (DCF)	-250k	62.48k	52.05k	78.17k	65.07k	54.27k
Cumulative Discounted Cash Flow	-250k	-187.52	-135.47k	-57.3k	7.77k	62.04k

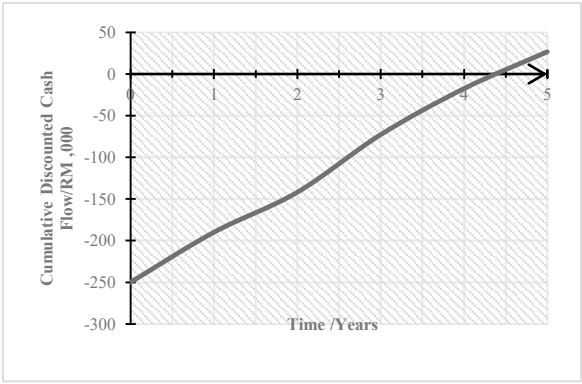
Net Present Value (NPV) = 62.04k
Payback Period = 3.81 years



Discounted Cash Flows for Interest Rate = 25%

Year	0	1	2	3	4	5
Cash Flow	-250k	75k	75k	135k	135k	135k
Discount Factor	1	0.800	0.640	0.512	0.410	0.328
Discounted Cash Flow (DCF)	-250k	60k	48k	69.12k	55.35k	44.28k
Cumulative Discounted Cash Flow	-250k	-190k	-142k	-72.88k	-17.53k	26.75k

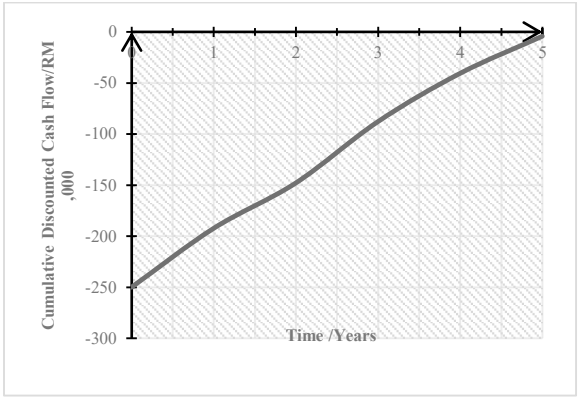
Net Present Value (NPV) = 26.75k
Payback Period = 4.39 years

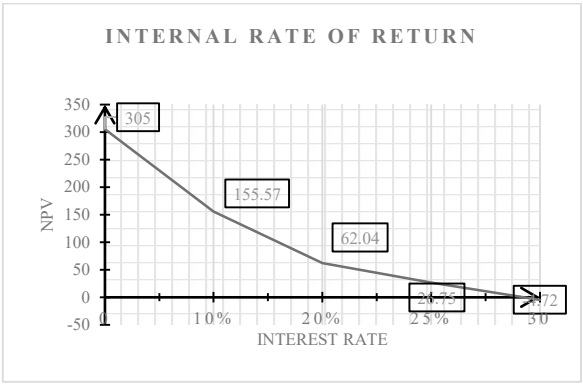


Discounted Cash Flows for Interest Rate = 30%

Year	*0*	*1*	*2*	*3*	*4*	*5*
Cash Flow	-250k	75k	75k	135k	135k	135k
Discount Factor	1	0.769	0.592	0.445	0.350	0.269
Discounted Cash Flow (DCF)	-250k	57.68	44.4k	60.08	47.25k	36.32k
Cumulative Discounted Cash Flow	-250k	-192.32k	-147.92k	-87.84k	-40.59k	-4.27k

Net Present Value (NPV) = - 4.72k
Payback Period = > 5 years





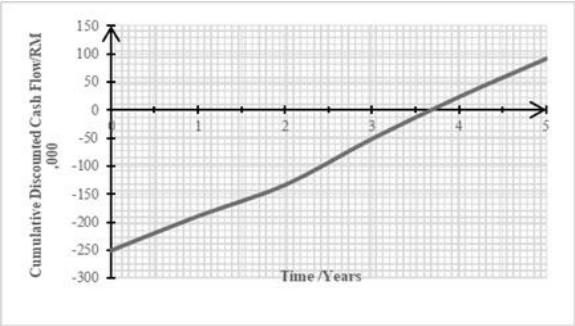
INTERNAL RATE OF RETURN = 28.9%

Year	1	2	3	4	5
Cash Flow	75k	75k	135k	135k	135k
Depreciation	50K	50K	50K	50K	50K
Taxable Income	25K	25k	85k	85k	85k
Tax (30%)	7.5K	7.5k	25.5k	25.5k	25.5k
After Tax Cash Flow	67.5k	67.5k	109.5k	109.5k	109.5k

After Tax Discounted Cash Flows for Interest Rate = 10%

Year	0	1	2	3	4	5
Cash Flow	-250k	67.5	67.5	109.5	109.5	109.5
Discount Factor	1	0.909	0.826	0.751	0.683	0.621
Discounted Cash Flow (DCF)	-250k	61.36	55.76	82.23	74.79	68.00
Cumulative Discounted Cash Flow	-250	-188.64	-132.89	-50.65	24.14	92.14

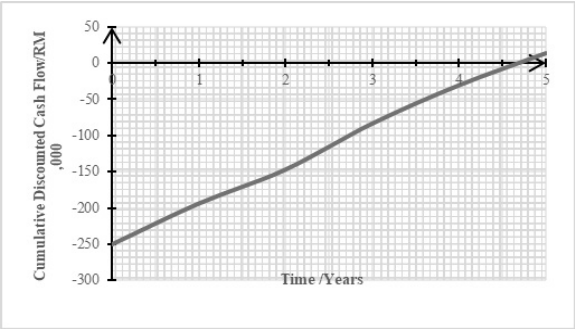
Net Present Value (NPV) = 92.135k
Payback Period = 3.72 years



After Tax Discounted Cash Flows for Interest Rate = 20%

Year	0	1	2	3	4	5
Cash Flow	-250	67.5	67.5	109.5	109.5	109.5
Discount Factor	1	0.833	0.694	0.579	0.482	0.402
Discounted Cash Flow (DCF)	-250	56.23	46.85	63.40	52.78	44.02
Cumulative Discounted Cash Flow	-250	-193.77	-146.93	-83.53	-30.75	13.27

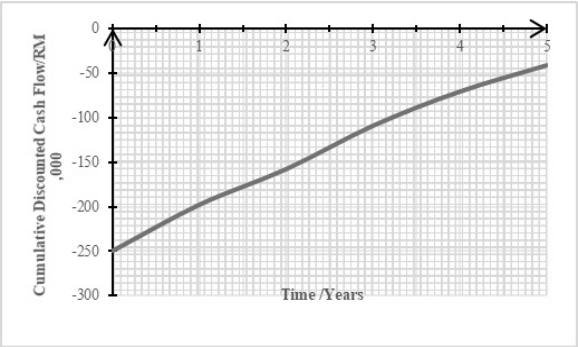
Net Present Value (NPV) = 13.27k
Payback Period = 4.72 years

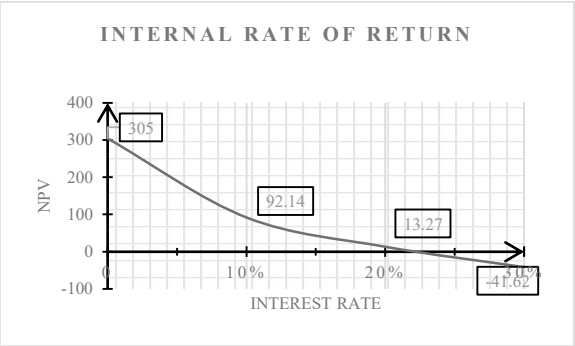


After Tax Discounted Cash Flows for Interest Rate = 30%

Year	0	1	2	3	4	5
Cash Flow	-250	67.5	67.5	109.5	109.5	109.5
Discount Factor	1	0.769	0.592	0.445	0.35	0.269
Discounted Cash Flow (DCF)	-250	51.91	39.96	48.73	38.33	29.46
Cumulative Discounted Cash Flow	-250	-198.09	-158.13	-109.41	-71.08	-41.62

Net Present Value (NPV) = -41.62k
Payback Period = > 5 years





INTERNAL RATE OF RETURN = 22.5 %

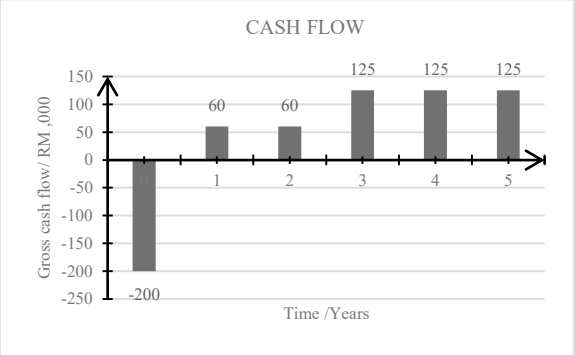
Project IV: Increase Wideness of Cupboard Space.
The data of the project:

- Initial investment (I) = RM 200,000
- Annual cost of operation = RM 15,000
- Planning horizon of 5 years

Expected annual revenues

- RM 75,000 for the first two years
- RM 140,000 for the next three years

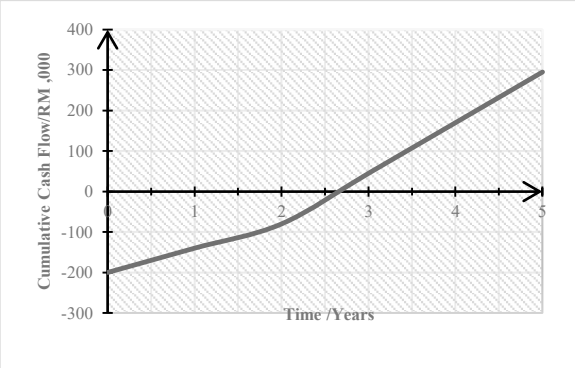
Year	0	1	2	3	4	5
Costs	-200k	-15k	-15k	-15k	-15k	-15k
Revenues		75k	75k	140k	140k	140k
Cash Flow	-200k	60k	60k	125k	125k	125k



Undiscounted Cash Flows Before Tax

Year	0	1	2	3	4	5
Cash Flow	-200k	60k	60k	125k	125k	125k
Cumulative Cash Flow	-200k	-140K	-80K	45K	170K	295K

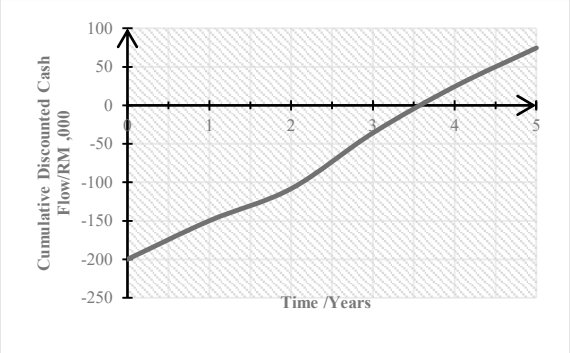
Net present value (NPV) = 295k
Payback Period = 2.60 years



Discounted Cash Flows for Interest Rate = 20%

Year	0	1	2	3	4	5
Cash Flow	-200k	60K	60K	125k	125k	125k
Discount Factor	1	0.833	0.694	0.579	0.482	0.402
Discounted Cash Flow (DCF)	-200k	49.98K	41.64K	72.38K	60.25K	50.25K
Cumulative Discounted Cash Flow	-200k	-150.02K	-108.38K	-36K	24.25K	74.5K

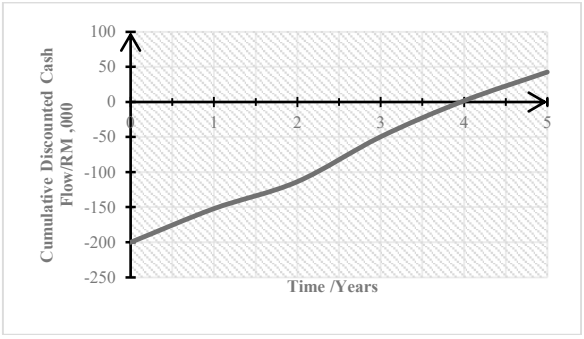
Net Present value (NPV) = 74.5k
Payback Period = 3.52 years



Discounted Cash Flows for Interest Rate = 25%

Year	0	1	2	3	4	5
Cash Flow	-200k	60K	60K	125K	125K	125K
Discount Factor	1	0.800	0.640	0.512	0.410	0.328
Discounted Cash Flow (DCF)	-200k	48K	38.4K	64K	51.25K	41K
Cumulative Discounted Cash Flow	-200k	-152K	-113.6K	-49.6K	1.65K	42.65K

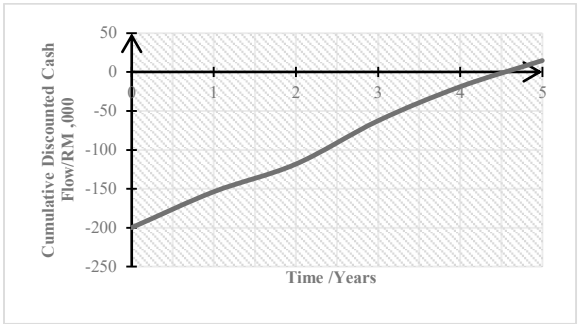
Net Present value (NPV) = 42.65k
Payback Period = 3.98 years



Discounted Cash Flows for Interest Rate = 30%

Year	0	1	2	3	4	5
Cash Flow	-200k	60K	60K	125K	125K	125K
Discount Factor	1	0.769	0.592	0.445	0.350	0.269
Discounted Cash Flow (DCF)	-200k	46.14K	35.52K	55.63K	43.75K	33.63K
Cumulative Discounted Cash Flow	-200k	-153.86K	-118.34K	-62.71K	-18.96K	14.67K

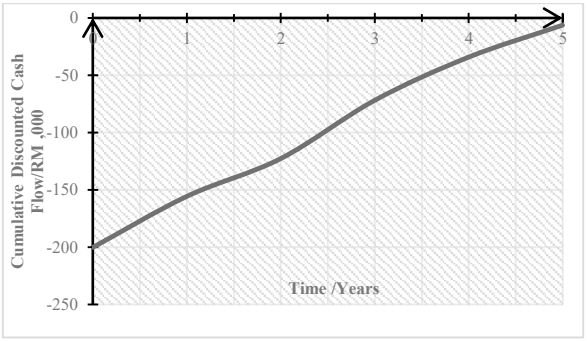
Net Present value (NPV) = 14.67k
Payback Period = 4.53 years

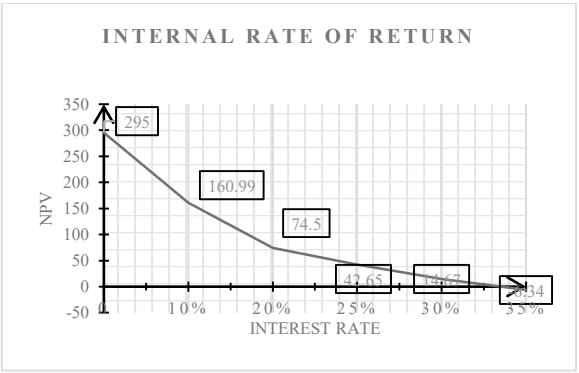


Discounted Cash Flows for Interest Rate = 35%

Year	0	1	2	3	4	5
Cash Flow	-200k	60K	60K	125K	125K	125K
Discount Factor	1	0.741	0.549	0.406	0.301	0.223
Discounted Cash Flow (DCF)	-200k	44.46K	32.94K	50.75K	37.63K	27.88K
Cumulative Discounted Cash Flow	-200k	-155.54K	-122.6K	-71.85K	-34.22K	-6.34K

Net Present value (NPV) = - 6.34k
Payback Period = > 5 years





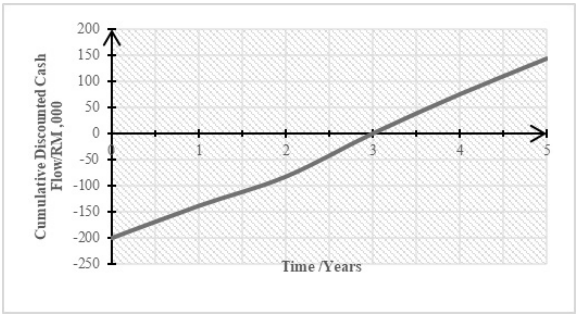
INTERNAL RATE OF RETURN = 33.5 %

Year	1	2	3	4	5
Cash Flow	60K	60K	125K	125K	125K
Depreciation	40K	40K	40K	40K	40K
Taxable Income	20K	20K	85k	85k	85k
Tax (30%)	6K	6k	25.5k	25.5k	25.5k
After Tax Cash Flow	54K	54k	99.5k	99.5k	99.5k

After Tax Discounted Cash Flows for Interest Rate = 10%

Year	0	1	2	3	4	5
Cash Flow	-200	67.5	67.5	109.5	109.5	109.5
Discount Factor	1	0.909	0.826	0.751	0.683	0.621
Discounted Cash Flow (DCF)	-200	61.36	55.76	82.23	74.79	68.00
Cumulative Discounted Cash Flow	-200	-138.64	-82.89	-0.65	74.14	142.14

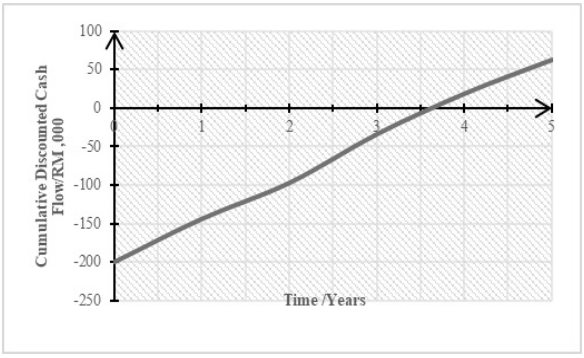
Net present value (NPV) = 142.14k
Payback Period = 3.00 years



After Tax Discounted Cash Flows for Interest Rate = 20%

Year	0	1	2	3	4	5
Cash Flow	-200	67.5	67.5	109.5	109.5	109.5
Discount Factor	1	0.833	0.694	0.579	0.482	0.402
Discounted Cash Flow (DCF)	-200	56.23	46.85	63.40	52.78	44.02
Cumulative Discounted Cash Flow	-200	-143.77	-96.93	-33.53	19.25	63.27

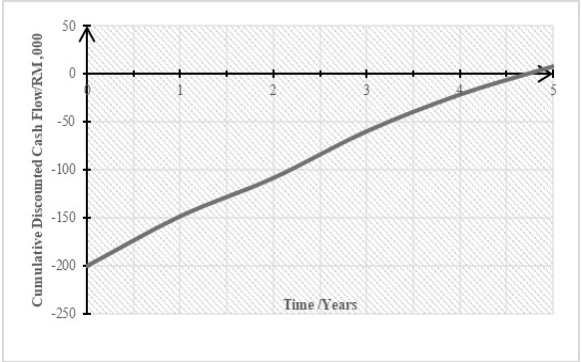
Net present value (NPV) = 63.27k
Payback Period = 3.59 years



After Tax Discounted Cash Flows for Interest Rate = 30%

Year	0	1	2	3	4	5
Cash Flow	-200	67.5	67.5	109.5	109.5	109.5
Discount Factor	1	0.769	0.592	0.445	0.35	0.269
Discounted Cash Flow (DCF)	-200	51.91	39.96	48.73	38.33	29.46
Cumulative Discounted Cash Flow	-200	-148.09	-108.13	-59.41	-21.08	8.38

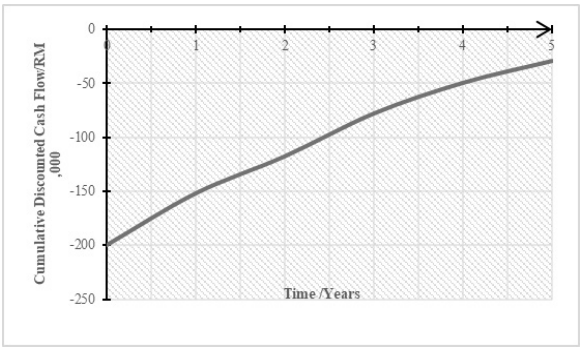
Net present value (NPV) = 8.38k
Payback Period = 4.73 years

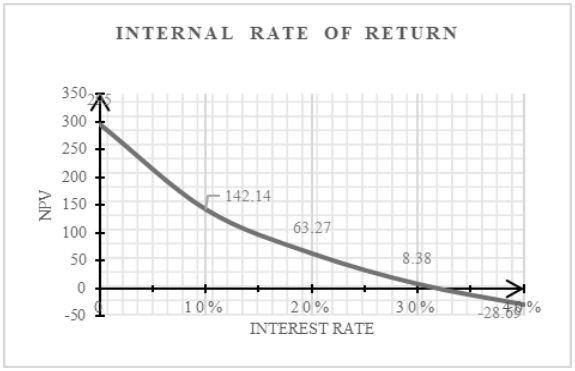


After Tax Discounted Cash Flows for Interest Rate = 40%

Year	0	1	2	3	4	5
Cash Flow	-200	67.5	67.5	109.5	109.5	109.5
Discount Factor	1	0.714	0.51	0.364	0.26	0.186
Discounted Cash Flow(DCF)	-200	48.20	34.43	39.86	28.47	20.37
Cumulative Discounted Cash Flow	-200	-151.81	-117.38	-77.52	-49.05	-28.69

Net present value (NPV) = - 28.69k
Payback Period = > 5 years





INTERNAL RATE OF RETURN = 32.5%

Conclusion

Project I		Rates (%)	Project IV	
NPV (RM)	PP (years)		NPV (RM)	PP (years)
305k	2.73	Undiscounted Before Tax	295k	2.60
155.57k	3.23	10	160.99k	3.01
62.04k	3.81	20	74.5k	3.52
26.75k	4.39	25	42.65k	3.98
-4.72k	> 5	30	14.67k	4.53
-	-	35	-6.34k	> 5
28.9		IRR (%)	33.5	
92.135k	3.72	10	142.14k	3.00
13.27k	4.72	20	63.27k	3.59
-41.62k	> 5	30	8.38k	4.73
-	-	40	- 28.68k	> 5
22.5		IRR (%)	32.5	

NPV values of “Project IV” is higher for all rates before tax and after tax compared to NPV values of “Project I”. As Higher NPV value. Both projects are feasible between 10% - 25% rates before tax and 10% - 20% after tax. However, as projects with highest NPV value is favored, “Project IV“ is the most suitable to be carried out. “Project IV “ also is expected to have a lower payback period compared to “Project I“ for all rates before and after tax. Finally “Project I“ is expected to produce a lower IRR (Internal Return Rate) compared to “ Project IV “. Projects with higher IRR rates are more profitable, therefore “Project IV“ is the best choice as its IRR is higher than the IRR of “Project I“ before and after tax.

CHAPTER 4

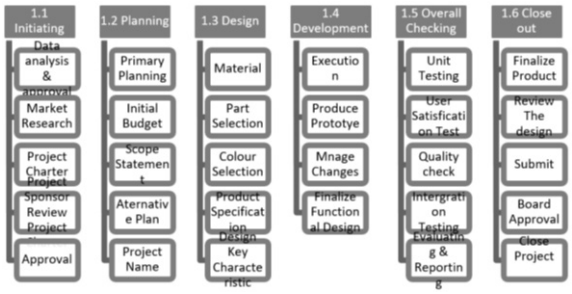
PROJECT PLANNING

Outcome based Education:

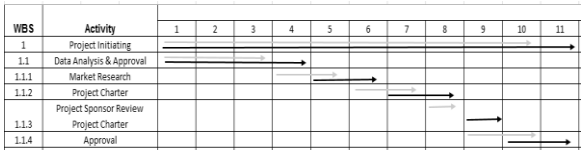
1. Students are able to develop a work breakdown structure (WBS) based on their product.
2. Students are able to assign task to resources from the constructed WBS.
3. Students are able to assign cost with task from the constructed WBS.
4. Students are able to develop a Gantt chart based on their product.
5. Students are able to estimate optimum demand with profit and profit range.

4.1 Reversible Umbrella

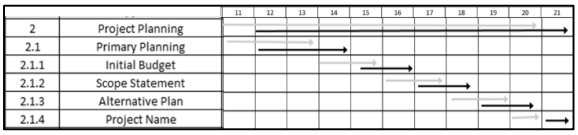
4.1.1 WBS Development



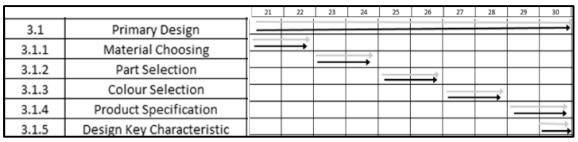
WBS 1



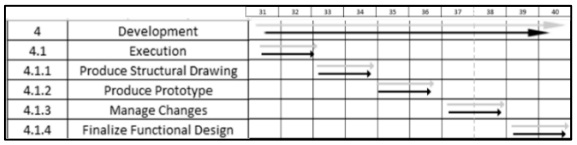
WBS 2



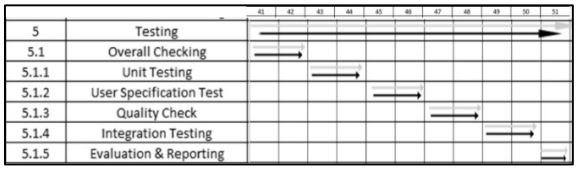
WBS 3



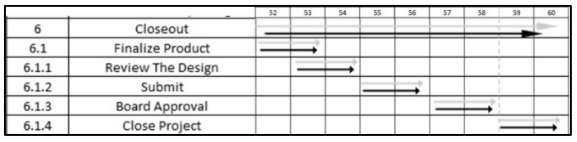
WBS 4



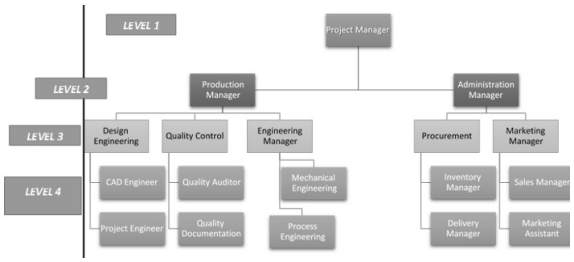
WBS 5



WBS 6



4.1.2 Assign Task to Resources



4.1.3 Assign Cost with Task

LICENSE RENEW

No	Resources	Cost per year/MYR	Total Cost
1	Business license	1100	1100
2	Manufacturing license	950	950
3	Quality engineer(license)	1500	1500
TOTAL			3550

PROTOTYPE

No	Resources	Unit	Price per unit/MYR	Total cost
1	CAD license	1	5000	5000
2	Metal(shaft)	5	25.50	127.50
3	Plastic (shaft)	5	35.00	175
TOTAL				5302.50

INSURANCE

No	Resources	Cost per year/MYR	Total cost
1	General liability insurance	10000	120000
2	Workers' compensation insurance	12000	144000
3	Business loan	20000	240000
TOTAL			504000

DELIVERY

No	Resources	Unit	Cost per month/MYR	Total cost
1	Transportation	5	7500	7500
2	Wi-fi	8	960	960
3	Packaging	1000	1500	1500
TOTAL				9960

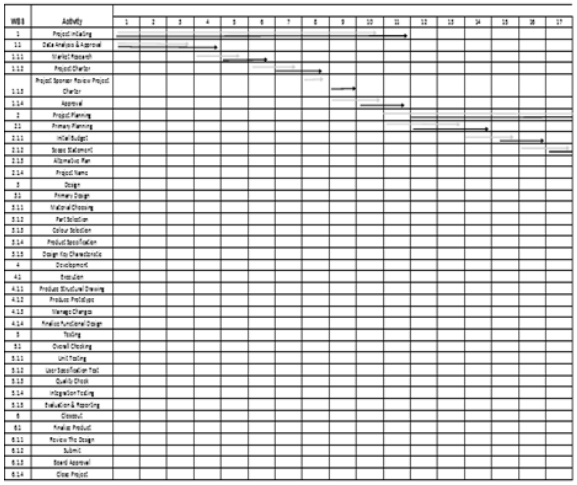
MARKETING

No	Resources	Cost per year/MYR	Total cost
1	Printer (Flyers)	3840	3840
2	Advertising(internet)	5600	5600
3	Promotion(Expo)	1000	1000
TOTAL			10440

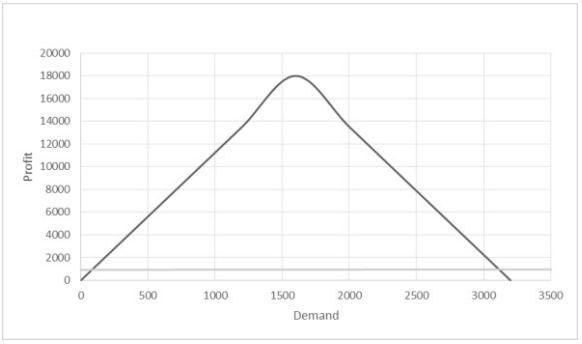
PAYROLL

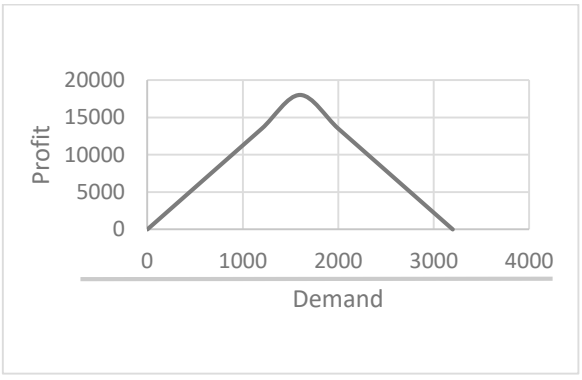
No	Resources	Cost per year/MYR	Total cost
1	Design engineering	9520	9520
2	Procurement	8600	8600
3	Engineering materials	10000	10000
TOTAL			28120

4.1.4 Gantt Chart



4.1.5 Estimating Demand with Profit and Range of Profit



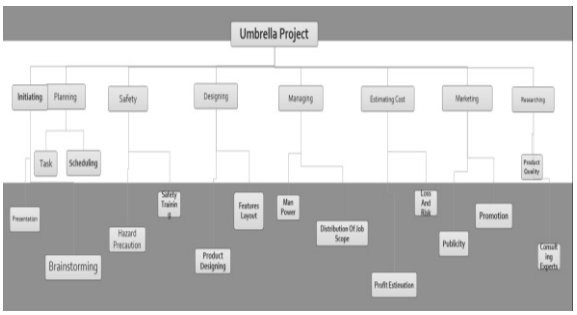


4.2 Bell-Shaped Umbrella

4.2.1 WBS Development

WBS is a hierarchical and incremental decomposition of the project into phases, deliverables and work packages. It is a tree structure, which shows a subdivision of effort required to achieve an objective; for example, a program, project, and contract.

For final decision project A design is selected. The design of the umbrella selected is the one which fulfil all the aspects agreed by both company and customer. The main idea is to make an umbrella according to the Scale of Assessment result. Therefore, our design must have UV protection. Can be foldable for easy storing. With extra of umbrella cover to avoid water dripping during storage. Our umbrella design also has the push button mechanism to make it easy to open it during emergency. Project A have higher profits than Project B. Therefore, Project A is selected during final evaluation.



4.2.2 Assign Task to Resources

Resource	Task
1.Sponsor manager Mr. Wai Kit	1.1 Provide model 1.2 Observe the project ideology mission and idea at all level.
2. Project manager Mr. Syazwan	2.1 Create proposal 2.2 Presenting the idea to the sponsor
3. Engineering manager Mr. Ameer	3.1 Provide supervisor to engineer. 3.2 Coordinate the activities in the field.
4. Construction manager Mr. Vishnu	4.1 Involve in the conceptual development of the project. 4.2 Schedule the project and budget the time before deadline.
5. Procurement Mr. Rizal	5.1 Obtains price quotes from the suppliers 5.2 Prepare purchase order.
6. Quality Miss. Puhanes	6.1 Quality control/ during the process . 6.2 Quality insurance/ customer review.
7. Safety Mr. Adam	7.1 Provide safety equipment. 7.2 Presence emergency staff.
8. Project control Miss. Mimie	8.1 Risk and lost management. 8.2 Provide cost and schedule control.

4.2.3 Assign Cost with Task

Though the associate cost with task is a required part of Project Management Plan, unlike time and scope management, it is not listed as a part of formally defined cost management process. The Develop Project management Plan in Integration Management involves creation of the cost management plan. Cost and Budget, these two words are used interchangeably in the exam. It is important to note that the step of creating the cost management plan exists irrespective of where it is created.

Product

NO.	Resources	Unit	Cost per Unit (MYR)	Total cost (MYR)
1	Steel	100	3.5	35
2	Canopy with UV protection	20	5	100
3	Handle	20	1	20
4	Plastic cover	20	2	40
Total cost (MYR)				195

Process

No.	Resources	Unit	Cost per Unit (MYR)	Total cost (MYR)
1	Computer	1	2000	2000
2	Machines	2	8000	16000
3	Man power	10	900	900
4	Containers	1	30	30
Total cost (MYR)				18930

Design Evaluation

NO.	Resources	Unit	Cost Per Unit(MYR)	Total cost (MYR)
1	Computer	1	3000	3000
2	Design graphics software	2	200	400
3	Designing engineer	2	2000	2000
4	Paper	5 reams	14	70
5	Printer	1	200	200
Total cost (MYR)				5670

BUSINESS INSURANCES

NO.	Resources	Time(Year)	Cost Per Year (MYR)	Total cost (MYR)
1	Loan Protection	1	350	350
2	Share Purchase Cover	1	400	400
3	Crisis Cover Income	1	1500	1500
Total cost (MYR)				2250

License Renew

No.	Resources	Cost per Year (MYR)	Total Cost(MYR)
1	Business License	500	500
2	Manufacturing License	1000	1000
3	License(Quality Engineer)	2500	2500
Total cost (MYR)			4000

Payroll

No.	Resourse	unit	Cost Per Year(MYR)	Total cost (MYR)
1	Manager	1	60000	60000
2	Engineers	2	30000	60000
3	Operator	2	9800	19600
4	Technician	1	13200	13200
Total cost (MYR)				152800

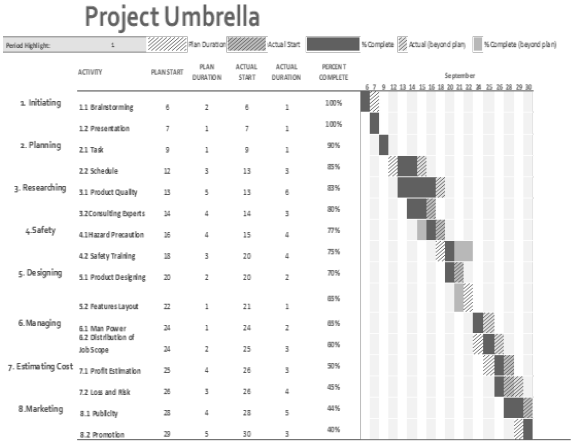
Marketing

No.	Resources	Cost Per Year(MYR)	Total cost (MYR)
1	Advertisement	1000	1000
2	Promoting	2500	2500
3	Venue rental	8000	8000
4	Flyers	500	500
Total cost (MYR)			12000

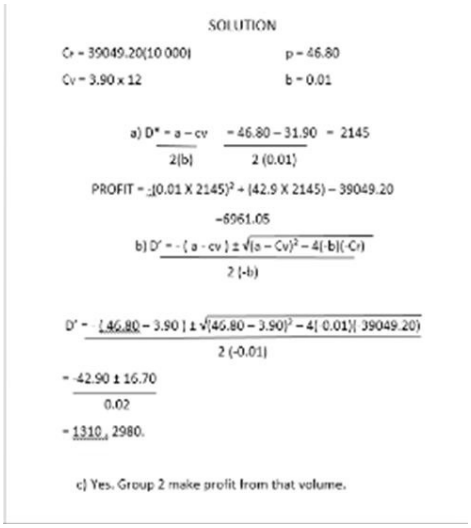
4.2.4 Gantt Chart Development

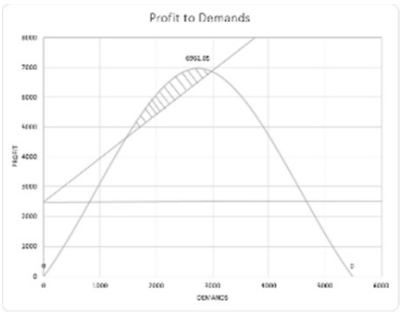
A Gantt chart, commonly used in project management, is one of the most popular and useful ways of showing activities (tasks or events) displayed against time. On the left of the chart is a list of the activities and along the top is a suitable time scale. Each activity is represented by a bar; the position and length of the bar reflects the start date, duration and end date of the activity. This allows us to see at a glance:

- What the various activities are
- When each activity begins and ends
- How long each activity is scheduled to last?
- The start and end date of the whole project



4.2.5 Estimating Demand with Profit and Range of Profit

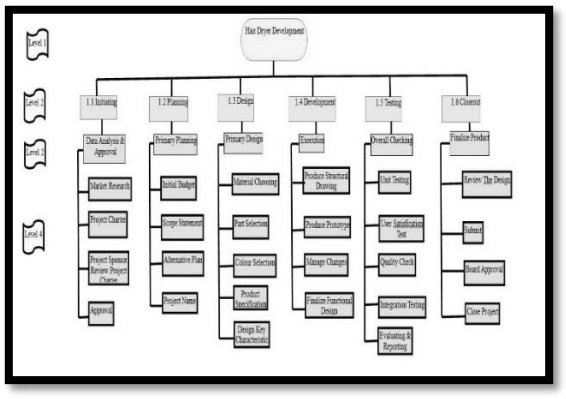




4.3 Hair Dryer

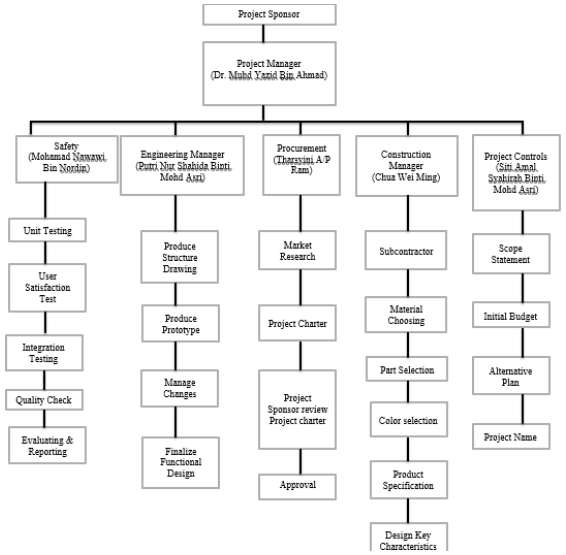
4.3.1 WBS Development

WBS is a key project deliverable that organizes the team's work into manageable sections. The Project Management Body of Knowledge. defines the work breakdown structure as a "deliverable oriented hierarchical decomposition of the work to be executed by the project team." The work breakdown structure visually defines the scope into manageable chunks that a project team can understand, as each level of the work breakdown structure provides further definition and detail. The WBS is functioned in our project in developing hairdryer.



4.3.2 Assign Task to Resources

Assign to resources of hairdryer consists 5 elements that is safety, Engineering Manager, Procurement, construction Manager, Project Control and had their sub jobs to the resources. Figure below shows the maps of Assign to Resources.



Names	Field	Jobs
Mohamad Nawawi Bin Nordin	Safety	• Unit Testing • User Satisfaction Test • Integration Testing • Quality Check • Evaluating & Reporting
Putri Nur Shahida Binti Mohd Asri	Engineering Manager	• Produce Structure Drawing (Solidworks) • Produce Prototype • Manage Changes • Finalize Functional Design
Tharsyini A/P Ram	Procurement	• Market Research • Project Charter • Project Sponsor review Project charter • Approval
Chua Wei Ming	Construction Manager	• Subcontractor • Material Choosing • Part Selection • Color selection • Product Specification • Design Key Characteristics
Siti Amal Syahirah Binti Mohd Asri	Project Controls	• Scope Statement • Initial Budget • Alternative Plan • Project Name

4.3.3 Assign Cost with Task

Cost consist many factors based on the WBS statements. It is market research, initial budget, material choosing, color selection, produce structural drawing, produce prototype, finalize functional design, quality check, evaluation and reporting, and finally review the design.

MARKET RESEARCH

No.	Resources	Units	Unit Price (MYR)	Total Price
1	Ionic hair dryer	1	466.65	466.65
2	Pensonic hair dryer	1	100.50	100.50
3	Modern hair dryer use Ground-Fault Circuit Interrupter (GFCI)	1	60.00	60.00
Total				627.15

INITIAL BUDGET

No.	Resources	Units	Unit Price (MYR)	Total Price
1	Drawing block (20 sheets)	1	4.80	4.80
2	Stationery set (Faber-Castell)	1	2.99	2.99
3	Laptop (Asus)	1	1 469.00	1 469.00
Total				1 476.79

MATERIAL CHOOSING

No.	Resources	Units	Unit Price (MYR)	Total Price
1	Electrical motor	1	20.00	20.00
2	Fan blade	1	18.90	18.90
3	Copper wiring	1	15.90	15.90
Total				54.80

COLOUR SELECTION

No.	Resources	Units	Unit Price (MYR)	Total Price
1	Bright	1	25.00	25.00
2	Dark	1	15.00	15.00
3	Clear plastic	1	20.00	20.00
Total				60.00

PRODUCE STRUCTURAL DRAWING

No.	Resources	Units	Unit Price (MYR)	Total Price
1	Laptop (Asus)	1	1 469.00	1 469.00
2	Drawing block (20 sheets)	1	4.80	4.80
3	switch	1	25.00	25.00
Total				1 498.80

PRODUCE PROTOTYPE

No.	Resources	Units	Unit Price (MYR)	Total Price
1	Laptop (Asus)	1	1 469.00	1 469.00
2	Plastic product (model)	1	50.99	50.99
3	Switch (model)	1	25.00	25.00
Total				1 544.99

FINALIZE FUNCTIONAL DESIGN

No.	Resources	Units	Unit Price (MYR)	Total Price
1	Powerful digital motor	1	100.00	100.00
2	Heat shield technology	1	43.50	43.50
3	Magnetic attachments	1	39.90	39.90
Total				183.40

QUALITY CHECK

No.	Resources	Units	Unit Price (MYR)	Total Price
1	Check sheet	1	12.90	12.90
2	License (quality engineer)	1	1 939.00	1 939.00
3	Polarized electrical plug	1	51.00	51.00
Total				2002.9

EVALUATION AND REPORTING

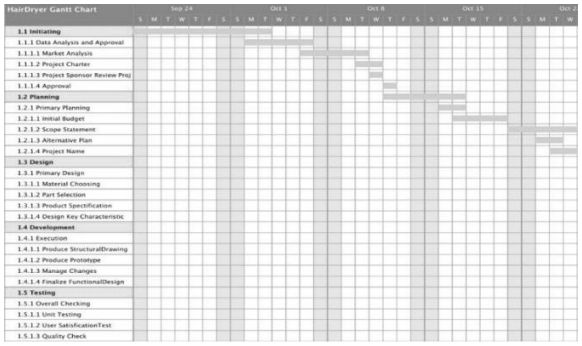
No.	Resources	Units	Unit Price (MYR)	Total Price
1	Laptop (Asus)	1	1 469.00	1 469.00
2	Testing for drying hair	1	25.00	25.00
3	Quality Functional Deployment	1	15.90	15.90
Total				1 509.90

REVIEW THE DESIGN

No.	Resources	Units	Unit Price (MYR)	Total Price
1	Diffuser	1	15.99	15.99
2	Smoothing nozzle	1	9.99	9.99
3	Styling concentrator	1	20.00	20.00
Total				45.98

4.3.4 Gantt Chart Development

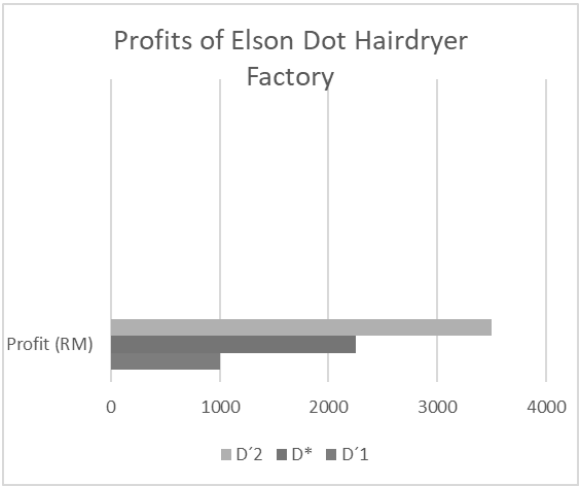
A Gantt chart is a type of bar chart that illustrates a project schedule. Gantt charts illustrate the start and finish dates of the terminal elements and summary elements of a project. Terminal elements and summary elements comprise the work breakdown structure of the project. Figure below shows how the schedule of masking hairdryer is performed.



4.3.5 Estimating Demand with Profit and Range of Profit

Elson Dot SDN. BHD. is a mega manufacturing factory in the hairdryer business industry. In producing hairdryers Elson Dot's fixed cost (Cf) is RM70000 per month with a variable cost (Cv) of RM60 per unit. The selling price for these high-end hairdryers is described by the equation a=RM150 – 0.02(b).

- What is the optimal volume of hairdryers?
- Does Elson Dot make a profit at that volume?
- What is the range of profitable demand?



What is the optimal volume of hairdryers?
Does Elson Dot make a profit at that volume?

$D^* = \frac{a-cv}{2b} = \frac{150-60}{2(0.02)}$ = RM 2250

Profit = - (0.02) $(2250)^2$ + (100) (2250) – 70000 = RM 53750

(a) What's is the range of profitable demand?

$D' = \frac{-(a-cv) \pm \sqrt{[(a-cv)^2-4(-b)(-cf)]}}{2(-b)}$

$D'1 = \frac{-(150-60)+\sqrt{[(150-60)^2-4(-0.02)(-70000)]}}{2(0.02)}$

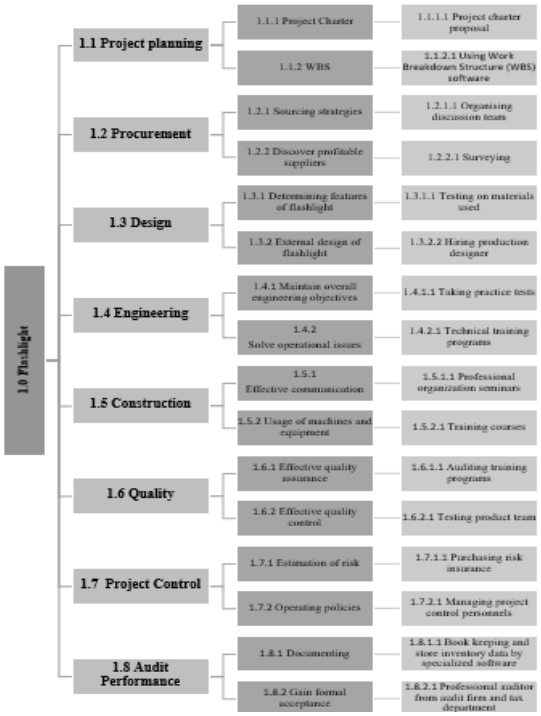
= RM 1000

$D'2 = \frac{-(150-60)-\sqrt{[(150-60)^2-4(0.02)(-70000)]}}{2(-0.02)}$

= RM3500

4.4 Touch Light

4.4.1 WBS Development



4.4.2 Assign Task to Resources and Assign Cost with Task

No.	WBS Element	Item	Description	Cost per month/unit/pax (RM)	Total cost (RM)
1	1.1.1.1	Project charter proposal			
			-1 unit	300.00	300.00
		-Purchase Charter template	-1 set of product	250.00	250.00
		-Microsoft Office license key to use feature tools	keys	500.00	500.00
		-Attend project development courses	-1 pax		
	1.1.2.1	Using Work Breakdown Structure (WBS) software			
			-1 unit	300.00	300.00
		-Purchase WBS software	-1 unit	250.00	250.00
		-Wages for clerks	-2 unit	500.00	1,000.00
		-Update to latest Windows version to support the software used			
2	1.2.1.1	Organizing discussion team			
			-3 units	50.00	150.00
		-Team meeting expenses	-1 unit	60.00	60.00
		reimbursement (pantry items)	-1 unit	40.00	40.00
		-Conference call fees			
		-Conference call agency service fees			
	1.2.2.1	Surveying			
		-Mileage claim	-2 pax	75.00	150.00
		-Survey form	-100 unit	0.20	20.00
		printing fee	-5 pax	60.00	300.00
		-Men power to distribute forms			
3	1.3.1.1	Testing on materials used			
			-1 unit	200.00	200.00
		-Consultation fees to suppliers' side	-2 pax	950.00	1,900.00
		-Document collection courses	-1 unit	100.00	100.00
		-Category sourcing scheduling programs			
	1.3.2.1	Hiring production designer			
			-1 unit	350.00	350.00
		-Advertising fee	-1 unit	250.00	250.00
		-Banner & bunting fees	-1 unit	3,000.00	3,000.00
		-Temporary designers' contract fees			
4	1.4.1.1	Taking practice tests			
		-Supplying chain management fee	-1 unit	200.00	200.00
		-Commission fee for successful project	-1 unit	200.00	200.00
		-Hunter premium packaging charges	-1 unit	120.00	120.00
	1.4.2.1	Technical training programs			
			-2 pax	550.00	1,100.00
		-Course fee	-2 pax	1,500.00	3,000.00
		-Practical training to overseas expenses	-1 unit	300.00	300.00
		-Consultation fees to expertised technicians			
5	1.5.1.1	Professional organization seminars			
			-2 pax	500.00	1,000.00
		-Guests & speaker invitation fees	-1 unit	2,000.00	2,000.00
		-Venue fee	-50 pax	10.00	500.00
		-Meal fee			
	1.5.2.1	Training courses			
			-2 pax	50.00	100.00
		-Travelling mileage claim	-2 pax	100.00	200.00
		-Expenses reimbursement	-2 pax	30.00	60.00
		- Travelling insurance for participants			
6	1.6.1.1	Auditing training programs			
			-1 pax	300.00	300.00
		-Participation fee	-1 pax	200.00	200.00
		-Installation of new accounting software and license key	-1 unit	150.00	150.00
		-Consultation fees			
	1.6.2.1	Testing product team			
		-Maintenance fee of machinery tools	-3 unit	300.00	900.00
		-Marketing survey	-1 unit	50.00	50.00
		-Disposal of defective products	-1 unit	100.00	100.00
7	1.7.1.1	Purchasing risk insurance			
			-1 unit	100.00	100.00
		-Insurance agency service fee	-1 unit	2,000.00	2,000.00
		-Annual renewal insurance fee	-1 unit	900.00	900.00
		-Policy amendment fees			
	1.7.2.1	Managing project control personnel			
			-1 unit	2,000.00	2,000.00
		-Team building programme	-4 pax	1,350.00	5,400.00
		-Training courses	-1 pax	500.00	500.00
		-Allowance and bonus for outstanding worker			
8	1.8.1.1	Book keeping and store inventory data by specialized software			
			-1 unit	400.00	400.00
		-Purchase license key	-1 pax	750.00	750.00
		-training fee to expert in the program			
		-men power	-1 pax	1,800.00	1,800.00
	1.8.2.1	Professional auditor from audit firm and tax department			
			-1 unit	2,800.00	2,800.00
		-Audit fee	-1 unit	2,700.00	2,700.00
		-Taxation service fee	-1 pax	1,050.00	1,050.00
		-Seminar for income tax current year			
Total Fixed Cost :					40,000

4.4.4 Gantt Chart Development

No	Activity	Day 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Project charter proposal																
2	Using Work Breakdown Structure (WBS) software																
3	Organizing discussion team																
4	Surveying																
5	Testing on materials used																
6	Taking practice tests																
7	Hiring production designer																
8	Technical training programs																
9	Professional organization seminars																
10	Training courses																
11	Auditing training programs																
12	Testing product team																
13	Purchasing risk insurance																
14	Managing project control personnel																
15	Book keeping and store inventory data by specialized software																
16	Professional auditor from audit firm and tax department																

4.4.5 Estimating Demand with Profit and Range of Profit

Cree Manufacturing is a major player in the Irrigation Services Company. Their high quality torchlight is used commercially and is quite popular for hikers. In producing these Cree's fixed cost (C_f) is \$40,000 per month with a variable cost (Cv) of \$10.05 per unit. The selling price for these is described by the equation p=\$85.00 – 0.02(D).

a) What is the optimal amount of torchlight?
b) Does Cree make a profit at that amount?
c) What is the range of profitable demand?

Solution

a) What is the optimal amount of torchlight? Does Cree make a profit at that amount?

$$D^* = \frac{a-C_v}{2b} = \frac{85.00-10.05}{2(0.02)} = \$1873.75$$

Profit = $- (0.02)(1873.75)^2 + (74.95)(1873.75) - 40{,}000 = \$30218.80$

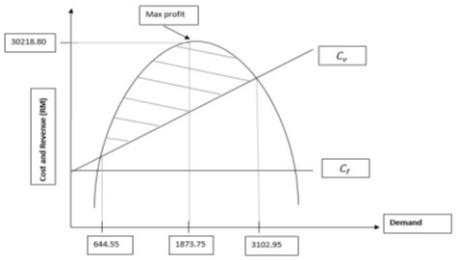
b) What is the range of profitable demand?

$$D' = \frac{-(a-C_v) \pm \sqrt{(a-C_v)^2 - 4(-b)(-C_f)}}{2(-b)}$$

$$D' = \frac{-(74.95) \pm \sqrt{(74.95)^2 - 4(-0.02)(-40000)}}{2(-0.02)}$$

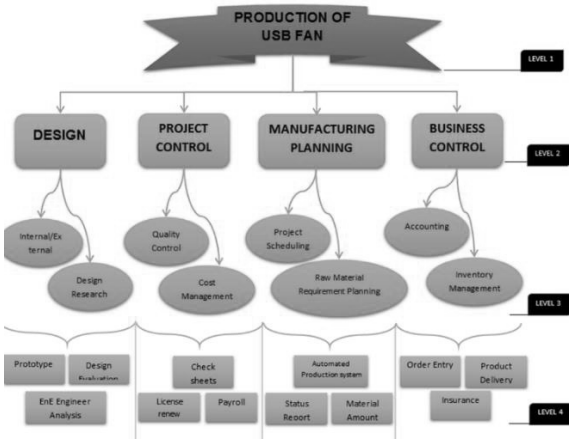
$$D' = \frac{-(74.95) \pm \sqrt{2417.50}}{-0.04}$$

$D'_1 = 644.55$ $D'_2 = 3102.95$



4.5 USB Fan

4.5.1 WBS Development



4.5.2 Assign Task to Resources

4.5.3 Assign Cost with Task

PROTOTYPE

NO	RESOURCES	UNIT	COST PER UNIT /MYR	TOTAL COST
1	COMPUTER (design graphics)(ASUS)	1	2300	2300
2	STEEL (model/design construction)	4	19.65	78.60
3	WOODEN BLOCKS (model/design construction)	3	11.80	35.50
TOTAL				2414.10

DESIGN EVALUATION

NO	RESOURCES	UNIT	COST PER UNIT /MYR	TOTAL COST
1	PAPERS (data/design support)	4 REAMS	13.20	52.80
2	COMPUTER (ASUS)/(design graphics)	1	1999.00	1999.00
3	FILES (documents)	7	23.00	161.00
TOTAL				2212.80

BUSINESS INSURANCE

NO	RESOURCES	TIME /YEAR	COST PER YEAR /MYR	TOTAL COST
1	LOAN PROTECTION	1	600 000	600 000
2	SHARE PURCHASE COVER	1	650 000	650 000
3	CRISIS COVER INCOME	1	300 000	300 000
TOTAL				1,550 000

LICENSE RENEW

NO	RESOURCES	COST PER YEAR /MYR	TOTAL COST
1	BUSINESS LICENSE	840.00	840.00
2	MANUFACTURING LICENSE	940.00	940.00
3	LICENSE (QUALITY ENGINEER)	1200.00	1200.00
TOTAL			2980.00

PAYROLL

NO	RESOURCES	NUMB.	COST PER UNIT /MYR	TOTAL COST
1	MANAGER	1	15 000	15 000
2	PROCESS ENGINEER	3	6000.00	18 000
3	INSTRUMENT ENGINEER	2	7500.00	15 000
TOTAL				48 000

STATUS REPORT

NO	RESOURCES	UNIT	COST PER UNIT /MYR	TOTAL COST
1	COMPUTER (APPLE)	3	3200.00	9600.00
2	PRINTER (HP)	3	548.55	1645.65
3	PAPERS (documents/proposal)	7 REAMS	15.70	109.90
TOTAL				11 355.55

AUTOMATED PRODUCTION SYSTEM

NO	RESOURCES	UNIT	COST PER UNIT /MYR	TOTAL COST
1	SOFTWARE (RAYCODE)(business information technology)	2	143.00	143.00
2	ATM (banking transaction process)	-	-	-
TOTAL				286.00

MATERIAL AMOUNT

NO	RESOURCES	UNIT	COST PER UNIT /MYR	TOTAL COST
1	CABLE WIRES	(4x10mm)	3.40 (2x10mm)	6.80
2	BLADE	1	3.70	3.70
3	FRONT GUARD	1	2.60	2.90
TOTAL				13.40

ORDER ENTRY

NO	RESOURCES	QUANTITY	COST PER UNIT/MYR	TOTAL COST
1	COMMUNICATION (telephone)	3	62.30	186.90
2	'WIFI' FACILITIES (online business)	2	97.00	194.00
3	SOFTWARE (NETSUITE MANUFACTURING EDITION)	1	110.00	110.00
TOTAL				490.90

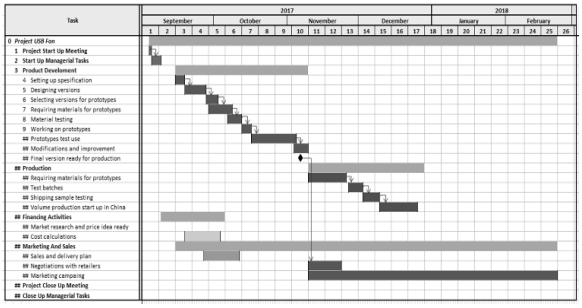
PRODUCT DELIVERY

NO	RESOURCES	QUANTITY	COST PER UNIT /MYR	TOTAL COST
1	'WIFI' FACILITIES	3	97.00	97.00
2	TRANSPORTATION	5	1700	8500.00
3	PACKAGING	500	7.00	3500.00
TOTAL				12 097.00

CHEEK SHEETS

NO	RESOURCES	UNIT	COST PER UNIT /MYR	TOTAL COST
1	LAPTOP(ASUS) (record management)	1	1222.00	1222.00
2	PRINTER(EPSON)	1	450.00	450.00
3	PAPERS (report)	5 REAMS	15.50	77.50
TOTAL				1749.50

4.5.4 Gantt Chart Development



4.5.5 Estimating Demand with Profit and Range of Profit

Zyphrus manufacturing is a distinguished industry in producing Multifunction USB fan. The USB fan produced by this company is well known and being used by most of the people. In producing these multifunction USB fan Zyphrus's fixed cost (Cp) is RM 60000 per month with a variable cost (Cv) of RM 16.00 per unit. The selling price for these multifunction USB fan is described by the equation p = RM 90.00 – 0.02(D).

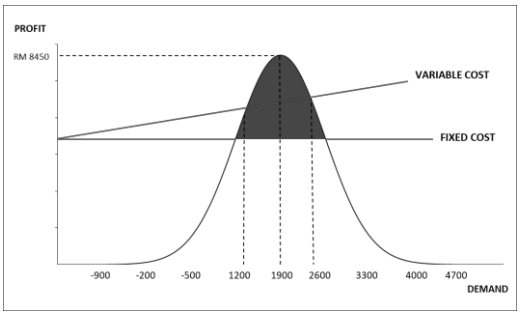
SOLUTIONS

a) $D = \frac{a-Cv}{2b} = \frac{90.00-16.00}{2(0.02)} = RM1850$

b) PROFIT $= -(b)(D)^2 + (a - Cv)(D) - Cp$
$= -(0.02)(1850)^2 + (90.00 - 16.00)(1850) - 60000 = RM 8450$

c) $= \frac{-(a-Cv) \pm \sqrt{(a-Cv)^2-4(-b)(-Cf)}}{2(-b)}$
$= \frac{-(90.00-16.00) \pm \sqrt{(90.00-16.00)^2-4(-0.02)(-60000)}}{2(-0.02)}$

D1 = 1200 D2 = 2600



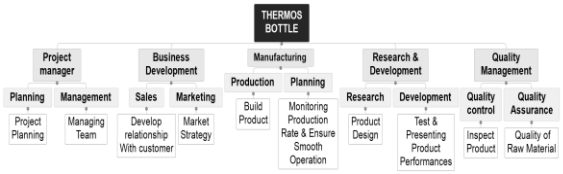
4.6 Thermos Flask

4.6.1 WBS Development

Project	Responsibility	Assigned to
Project Manager	-planning and monitoring the project -preparing and maintaining project, stage and exception plans as required.	Ms Tan Yong Ting
Business Analyst	- Assisting with the business case - Uncover the underlying business issues that need to be addressed and discover any information related to the project.	Mr Yong Wai Xhuen
Production Engineer	- Helping the team understand performance targets and goals. - Training or ensuring that workers are properly trained for their specific roles.	Mr Norman Bin Zaidin
Designer	- Create designs for the project - eliminate foreseeable health and safety risks to anyone affected by the project	Mr How Yong Chen
Quality Control Manager	- Achieves quality assurance operational objectives - Maintains and improves product quality.	Mr Muhamad Ashraf Bin Abdul Murad

Level	WBS Element	Work Breakdown
Level 1	1.1	Thermos Bottle
Level 2	1.1	Project Manager
Level 2	1.2	Business Development
Level 2	1.3	Manufacturing
Level 2	1.4	Research & Development
Level 2	1.5	Quality Management
Level 3	1.1.1	Planning
Level 3	1.1.2	Management
Level 3	1.2.1	Sales
Level 3	1.2.2	Marketing
Level 3	1.3.1	Production
Level 3	1.3.2	Planning
Level 3	1.4.1	Research
Level 3	1.4.2	Development
Level 3	1.5.1	Quality Control
Level 3	1.5.2	Quality Assurance
Level 4	1.1.1.1	Project Planning
Level 4	1.1.1.2	Budget Planning
Level 4	1.1.2.1	Managing Team
Level 4	1.1.2.2	Managing Expectations
Level 4	1.2.1.1	Pre-sale Technical Support
Level 4	1.2.1.2	Develop Relationship with customer
Level 4	1.2.2.1	Identifying new market
Level 4	1.2.2.2	Market Strategy
Level 4	1.3.1.1	Develop Manufacturing Process
Level 4	1.3.1.2	Build Product
Level 4	1.3.2.1	Raw Material Purchase order and delivery schedules
Level 4	1.3.2.2	Monitoring production rates & ensure smooth operations
Level 4	1.4.1.1	Product Design
Level 4	1.4.1.2	Raw Material Source Searching
Level 4	1.4.2.1	Suggest Improvement
Level 4	1.4.2.2	Test and presenting product performances
Level 4	1.5.1.1	Monitor Operations
Level 4	1.5.1.2	Inspect Product
Level 4	1.5.2.1	Review Design
Level 4	1.5.2.2	Quality of Raw Material

4.6.2 Assign Task to Resources



4.6.3 Assign Cost with Task

Develop Relationship with customer

No	Resources	Units	Unit price	Total price
1.	Thermos holder	500	15	7500
2.	Pamphlet	10000	0.30	3000
3.	Receipt paper	1 box	200	200
Total				10700

Project Planning

No	Resources	Units	Unit price	Total price
1.	Laptop (Acer)	1	2599	2599
2.	Printer	1	259	259
3.	A4 paper	1carton	65	65
Total				2323

Product Design

No	Resources	Units	Unit price	Total price
1.	Sketching paper	1 carton	80	80
2.	Ink	10 set	26	260
3.	Printer	1	259	259
Total				599

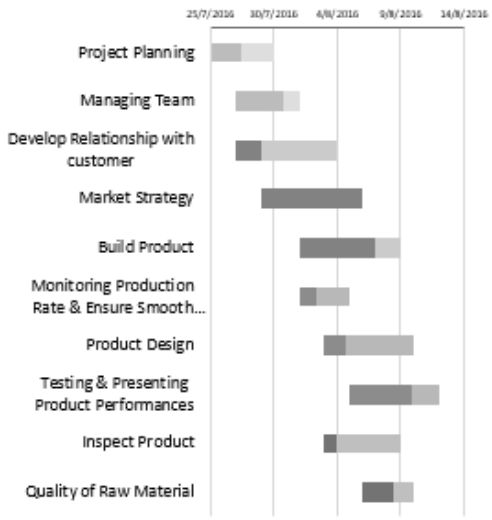
Pre-sale Technical Support

No	Resources	Units	Unit price	Total price
1.	Laptop (Acer)	1	2555	2555
2.	Thermos bottle	5	80	400
3.	Printer	1	259	259
Total				3214

Raw Material Purchase order and delivery schedules

No	Resources	Units	Unit price	Total price
1.	Shipping fee	10kg	10 per kg	100
2.	Laptop (hp)	1	1999	1999
3.	A4 paper	1carton	65	65
Total				2164

4.6.4 Gantt Chart Development



4.6.5 Estimating Demand with Profit and Range of Profit

Canty Manufacturing is a major player in the thermos tumbler. Their high technology of heat conservation and fashionable design is very popular and affordable. In producing these design's fixed cost (C_F) is $ 19,000 per month with a variable cost (C_v) of $10.50 per unit. The selling price for these is described by the equation p=$80.50 – 0.02($D$).

What is the optimal amount of the thermos bottle?
Does Canty make a profit at that volume?
What is the range of profitable demand?

$$D^* = x = \frac{a-C}{2b} = x = \frac{80.50-10.50}{2(0.02)} = \$1750$$

$$\text{Profit} = -(0.02)(1750)^2 + (70)(1750) - 19{,}000 = \$\,42250$$

$$D' = \frac{-(a-C_v)\pm\sqrt{(a-C_v)^2-4(-b)(C_F)}}{2(-b)}$$

$$D' = \frac{-(70)\pm\sqrt{(70)^2-4(-0.02)(19000)}}{2(-0.02)}$$

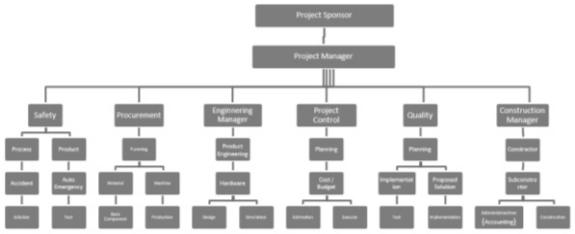
D = 3203 and 297. Thus, the range of the profitable demand is 297-3203 units per month.

4.7 Portable Fan

4.7.1 WBS Development

LEVEL	WBS	WORK BREAKDOWN
Level 1	1	Safety
Level 2	1.1	Process
Level 2	1.2	Product
Level 3	1.1.1	Accident
Level 3	1.2.1	Auto Emergency
Level 4	1.1.1.1	Solution
Level 4	1.2.1.1	Test
Level 1	2	Procurement
Level 2	2.1	Planning
Level 3	2.1.1	Material
Level 3	2.1.2	Machine
Level 4	2.1.1.1	Basic component
Level 4	2.1.2.1	Production
Level 1	3	Enginenering Manager
Level 2	3.1	Product Enginnering
Level 3	3.1.1	Hardware
Level 4	3.1.1.1	Design
Level 4	3.1.1.2	Simulation
Level 1	4	Project Control
Level 2	4.1	Planning
Level 3	4.1.1	Cost / Budget
Level 4	4.1.1.1	Estimation
Level 4	4.1.1.2	Execution
Level 1	5	Quality
Level 2	5.1	Planning
Level 3	5.1.1	Implementation
Level 3	5.1.2	Proposed Solution
Level 4	5.1.1.1	Test
Level 4	5.1.2.1	Implementation
Level 1	6	Contruction Manager
Level 2	6.1	Contractor
Level 3	6.1.1	Subcontractor
Level 4	6.1.1.1	Administractive
Level 4	6.1.1.2	Constructive

4.7.2 Assign Task to Resources



4.7.3 Assign Cost with Task

Safety

NO.	TASK	RESOURCES	COST
1.	Prepare first aid	Medical Kit Accident Book Bandage	RM15.00 x 1 unit RM5.00 x 1 unit RM10.00 x 2unit
2.	Trial Test	LED Emergency Light Wire Motor	RM6.00 x 6 unit RM4.00 x 3 unit RM3.00 x 2 unit
Total			RM94.00

Engineering Manager

NO.	TASK	RESOURCES	COST
1.	Electronic Design	Electrical Board Charged Storage Device	RM40.00 x 1 unit RM15.00 x 1 unit
2.	System Simulation	Simulation Services Simulation Software	Rm50.00 x 1 unit RM100 x 1 unit
Total			RM205.00

Project Control

NO.	TASK	RESOURCES	COST
1.	Estimation	Pen Paper Work Calculator	RM1.00 x 6 unit RM10.00 x 1 unit RM35.00 x 1 unit
2.	Executive	Rent Machine Rent Factory Repair Machine	RM100.00 x 12 months RM100.00 x 12 months RM100 x 1 unit
Total			RM2500.00

Quality

NO.	TASK	RESOURCES	COST
1.	Model	Machine Process Plan Basic Component	RM100.00 x 12 months RM20.00 x 3 unit RM20.00 x 12 unit
2.	Functional Test And Manual	Computer Rent Model Machine	RM50 x I unit RM50.00 x 3 unit RM100.00 x 12 months
Total			RM2900.00

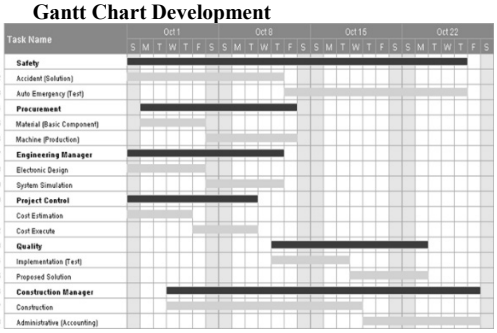
Procurement

NO.	TASK	RESOURCES	COST
1.	Basic Component	Motor Blade Switch	RM3.00 x 5 unit RM5.00 x 5 unit RM2.00 x 2 unit
2.	Production	Screw driver Milling machine (rent) Wiring Machine	RM3.00 x 3 unit RM50 x 12 months RM5.00 x 5 unit
Total			RM678.00

Construction Manager

NO.	TASK	RESOURCES	COST
1.	Accounting	Calculator Computer Rent	RM35.00 x 2 unit RM50.00 x 1 unit
2.	Construction	Manpower Materials Machining	RM15 x 1 hour RM 50 x 5 unit RM100
Total			RM485.00

4.7.4 Gantt Chart Development



4.7.5 Estimating Demand with Profit and Range of Profit

1) Optimal Volume

$$D^* = \frac{a - C_v}{2b} = \frac{70 - 30}{2(0.02)} = Rm1000$$

2) Profit

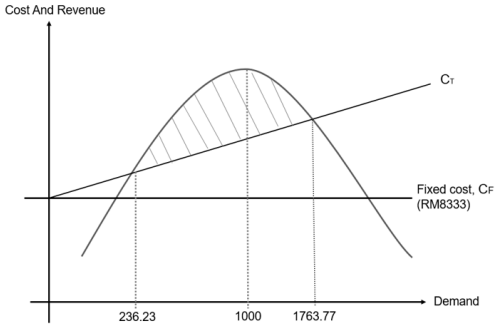
$$\text{Profit} = -(0.02)(1000)^2 + (40)(1000) - 8333$$

3) Range of Profitable Demand

$$D' = \frac{-(a - C_v) \pm \sqrt{(a - C_v)^2 - 4(-b)(-C_f)}}{2(-b)}$$

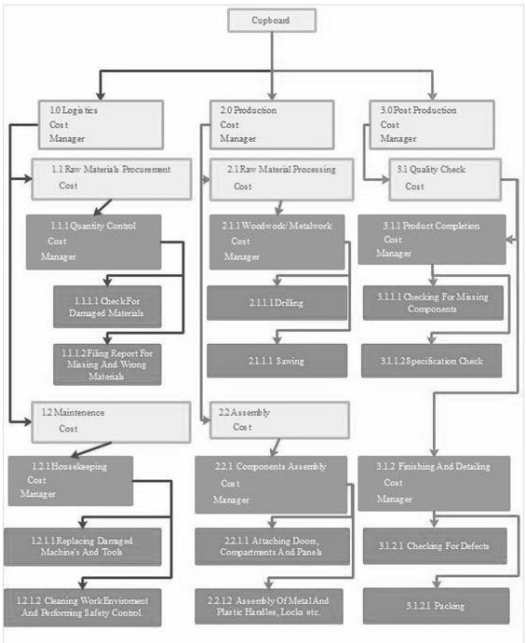
$$D' = \frac{-(70 - 30) \pm \sqrt{(70 - 30)^2 - 4(-0.02)(-8333)}}{2(-0.02)}$$

$$D_1' = Rm236.23 \qquad D_2' = Rm1763.77$$



4.8 Cupboard

4.8.1 WBS Development



4.8.2 Assign Task to Resources

4.8.3 Assign Cost with Task

Checking for Damage Materials

NO	RESOURCES	UNITS	UNIT PRICE (MYR)	TOTAL PRICE
1	WOOD TESTING DRILL (IML-RESI)	1	3900.00	3900.00
2	LICENSE (QUALITY ENGINEER)	1	1939.00	1939.00
3	SCHECK SHEET	1 REAM	12.90	12.90
TOTAL				5851.90

Filling Report for Missing and Wrong Materials

NO	RESOURCES	UNITS	UNIT PRICE (MYR)	TOTAL PRICE (MYR)
1	LAPTOP (ASUS)	1	1649.00	1649.00
2	PRINTER (CANON)	1	209.00	209.00
3	SOFTWARE (BIRT PROJECT)	1	120.00	120.00
TOTAL				1978.00

Replacing Damaged Machine's and Tools

NO	RESOURCES	UNITS	UNIT PRICE (MYR)	TOTAL PRICE
1	DRILL GUN (BOSCH)	1	408.00	408.00
2	JIGSAW (BOSCH)	2	285.00	570.00
3	BANDSAW (JWBS 9)	1	1039.00	1039.00
TOTAL				1649.00

Cleaning Work Environment and Preforming Safety Control

NO	RESOURCES	UNITS	UNIT PRICE (MYR)	TOTAL PRICE
1	STANDARD OPERATION PROCEDURE SIGNBOARD	2	100.00	200.00
2	SAFETY CAUTION SIGNBOARD	2	100.00	200.00
3	CLEANING TOOLS	5	20.00	100.00
TOTAL				500.00

Drilling

NO	RESOURCES	UNITS	UNIT PRICE (MYR)	TOTAL PRICE
1	DRILL GUN (BOSCH)	1	408.00	408.00
2	DRILL BIT (19 PCS)	1	29.50	29.50
3	CENTER PUNCH	1	19.60	19.60
TOTAL				457.10

Sawing

NO	RESOURCES	UNITS	UNIT PRICE (MYR)	TOTAL PRICE
1	JIGSAW (BOSCH)	2	285.00	570.00
2	JIGSAW BLADE (BOSCH)	2	20.00	40.00
3	BANDSAW (JWBS 9)	1	1039.00	1039.00
TOTAL				1649.00

Attaching Doors, Compartments and Panels

NO	RESOURCES	UNITS	UNIT PRICE (MYR)	TOTAL PRICE
1	METAL NAIL	2 BOX	10.00	20.00
2	RIVET NAIL	1 BOX	10.00	10.00
3	SILICON RUBBER MICROWAVE	2	2.00	8.00
TOTAL				38.00

Assembly of Metal and Plastic Handles, Locks Etc.

NO	RESOURCES	UNITS	UNIT PRICE (MYR)	TOTAL PRICE
1	METAL DOOR HOLDER	2	85.00	170.00
2	METAL LOCKS	2	48.00	96.00
3	LOCKS KEY	3	5.00	15.00
TOTAL				281.00

Checking for Missing Component

NO	RESOURCES	UNITS	UNIT PRICE (MYR)	TOTAL PRICE
1	PAPER (CHECK SHEET)	5 REAMS	13.8	69.00
2	LAPTOP (ASUS)	1	1649.50	1649.00
3	PRINTER (CANON)	1	209.00	209.00
TOTAL				1927.00

Specification Check

NO	RESOURCES	UNITS	UNIT PRICE (MYR)	TOTAL PRICE
1	TAPE MEASURE (10M DELI)	1	20.00	20.00
2	LEVEL (ALUMINIUM ALLOY)	1	12.50	12.50
3	LAPTOP (ASUS)	1	1649.00	1649.00
TOTAL				1681.5

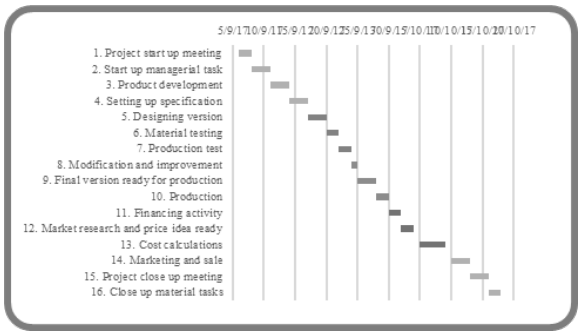
Checking for Defect

NO	RESOURCES	UNITS	UNIT PRICE (MYR)	TOTAL PRICE
1	PAPER (CHECK SHEET)	1 REAM	13.00	13.00
2	LICENSE (QUALITY ENGINEER)	1	1800.00	1800.00
3	LAPTOP (ASUS)	1	1649.00	1649.00
TOTAL				3462.00

Packing

NO	RESOURCES	UNITS	UNIT PRICE (MYR)	TOTAL PRICE
1	PLASTIC WRAPPER	1	40.00	40.00
2	RATCHET TIE	2	100.00	200.00
3	COURIER SERVICE	1	520.00	520.00
TOTAL				760.00

4.8.4 Gantt Chart Development



4.8.5 Estimating Demand with Profit and Range of Profit

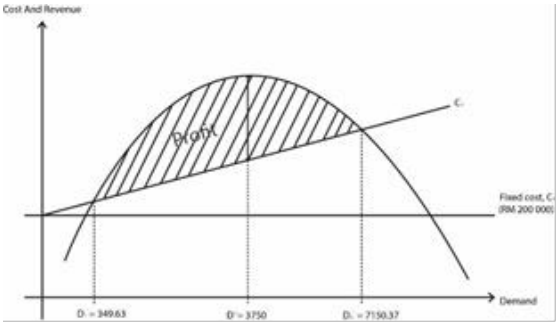
The production of the cupboard fixed cost (CF) is RM200 000 per month with a variable cost (cv)of RM600 per unit, the selling price for the high quality cupboard is described by the equation p=RM1200 – 0.08(D).

Price of the cupboard, P=1200
Demand, D= 0.08

$$D^* = \frac{1200 - 600}{2(0.08)}$$
$$= 3750$$
$$Profit = -(0.08)(3750)^2 + (600)(3750) - 200\,000$$
$$= 925\,000$$

Range of the profitable demand, D'

$$D' = \frac{-(1200 - 600) \pm \sqrt{(1200 - 600)^2 - 4(-0.08)(-200\,000)}}{2(-0.08)}$$
$$D_1' = 349.63\ units$$
$$D_2' = 7150.37 units$$



The shaded region shows the range of profitable demands. Thus the range of profitable demands is 349 – 7,150 units per month.

CHAPTER 5

PROJECT EXECUTING

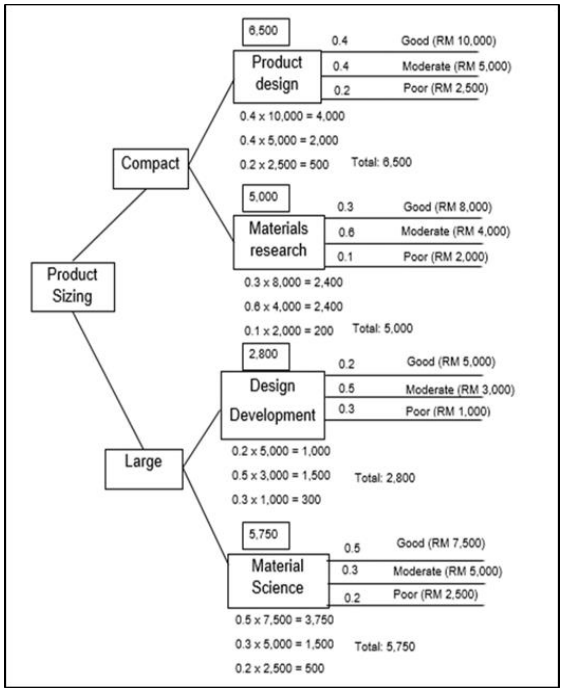
Outcome based Education:

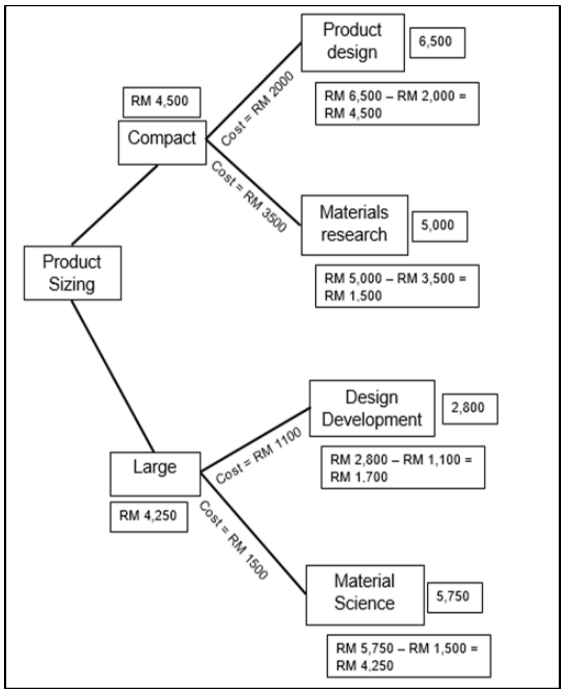
1. Students are able to analyze a decision using decision tree method.

5.1 Reversible Umbrella

5.1.1 Decision Tree Analysis

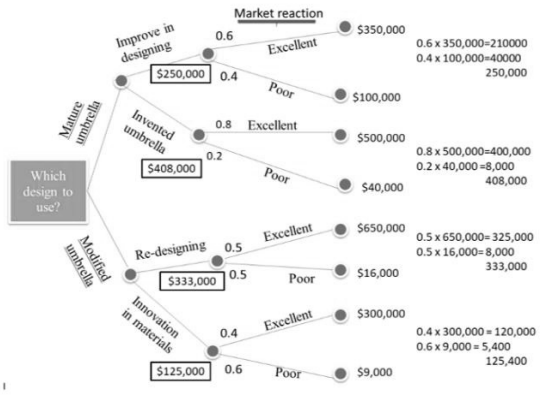
Should we develop a product (reversed umbrella) that focus on compact size or large size?

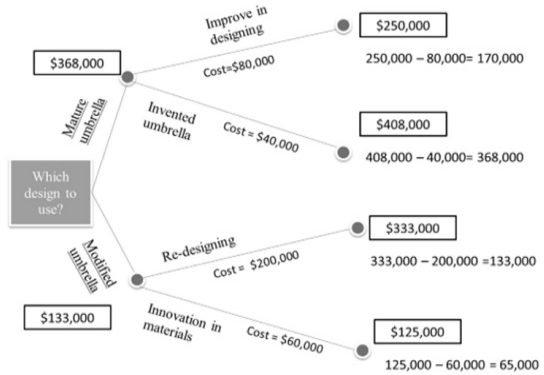




5.2 Bell-Shaped Umbrella

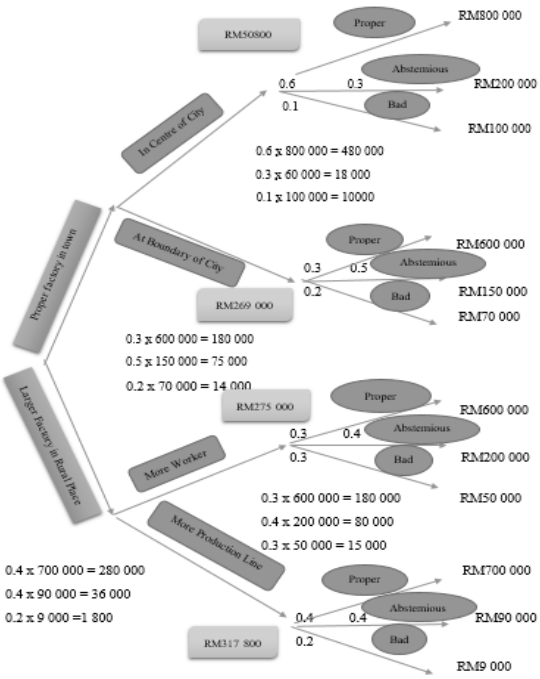
5.2.1 Decision Tree Analysis

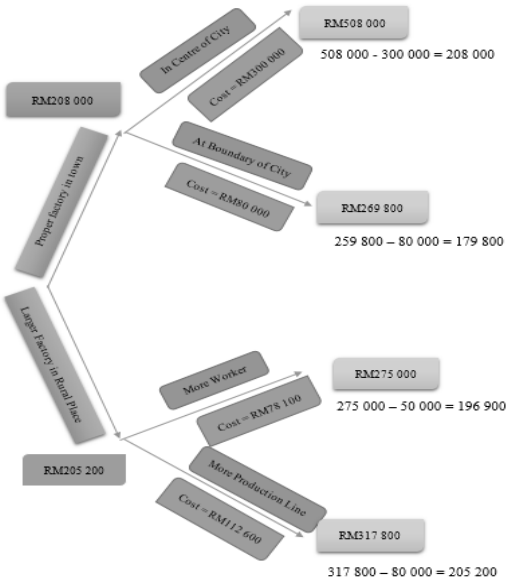




5.3 Hair Dryer

5.3.1 Decision Tree Analysis

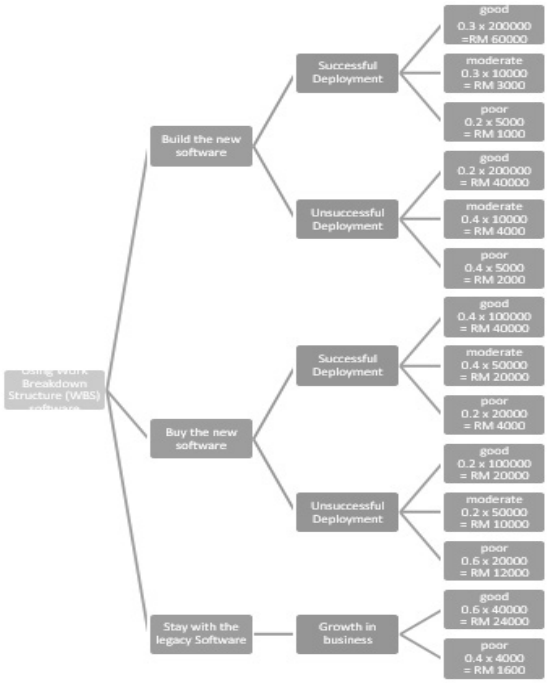




Based on Decision Tree Analysis, the benefit we previously calculated for 'Proper factory in town in centre of city, 'was RM508 000. We estimate the future cost of this approach as RM300 000. This gives a net benefit of RM208 800. The net benefit of 'Larger factory in rural places, More Production Line' was RM205 200. On this branch, we choose the most valuable option, 'Proper factory in town, in centre of city', and allocate this value to the decision node.

5.4 Touch Light

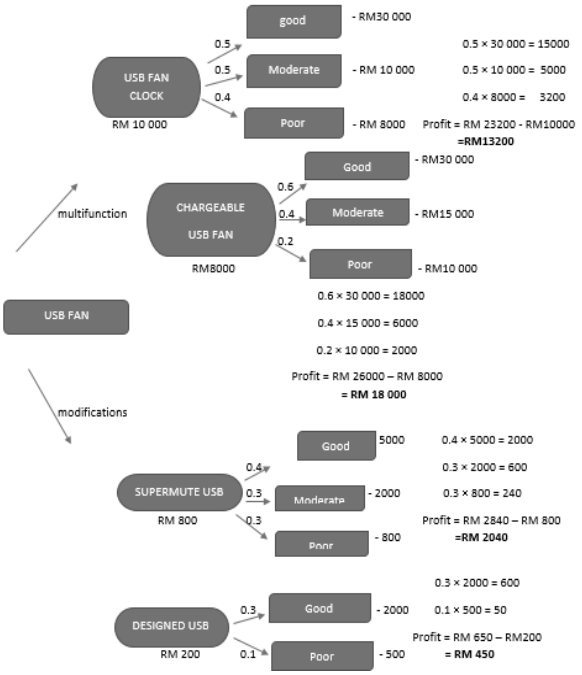
5.4.1 Decision Tree Analysis



In the decision tree analysis, the benefit we previously calculated for 'Buy a new software and successful deployment' was RM 64000.We estimate the future cot of this approach as RM20000. This gives a net benefit of RM 44000. The net benefit of "Buy a new software but unsuccessful deployment" was RM 35000. Based on decision tree analysis we choose the most valuable option, 'Buy a new software and successful deployment' and allocate this value to the decision node. By using this technique, we can see that the best option is to 'Buy a new software'.

5.5 USB Fan

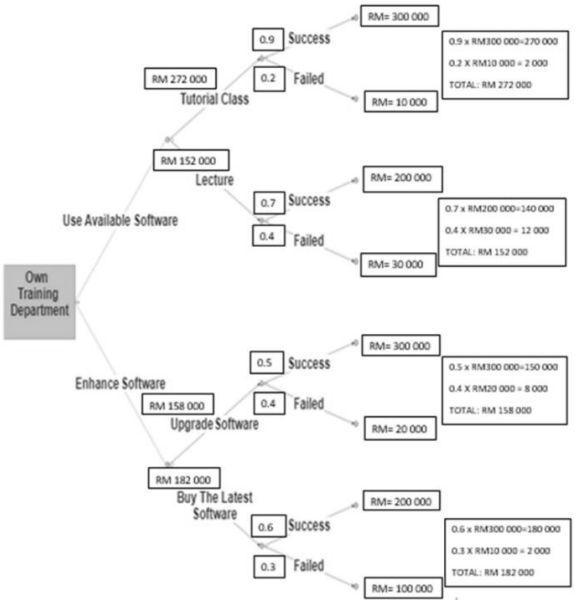
5.5.1 Decision Tree Analysis

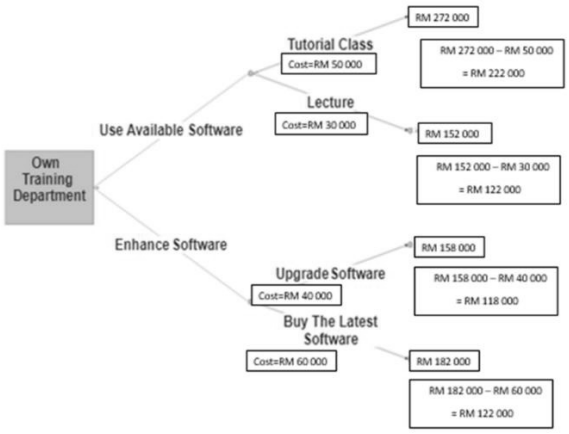


In reference to the decision tree, the benefit we previously calculated for USB fan for multifunction, chargeable USB fan was RM 26 000. We estimate the future cost of this product as RM 8000. This gives a net benefit of RM 18 000. The net benefit of multifunction USB fan, USB fan clock was RM 13200.Hence we therefore choose the most valuable option, multifunction USB fan, chargeable USB fan and allocate this value to the decision node. By applying this technique it's obvious that the best option is to produce multifunction USB fan. It is worth much time to us to spend our time in producing multifunction USB fan than wasting the time pondering of the types of designs to apply to the USB fan.

5.6 Thermos Flask

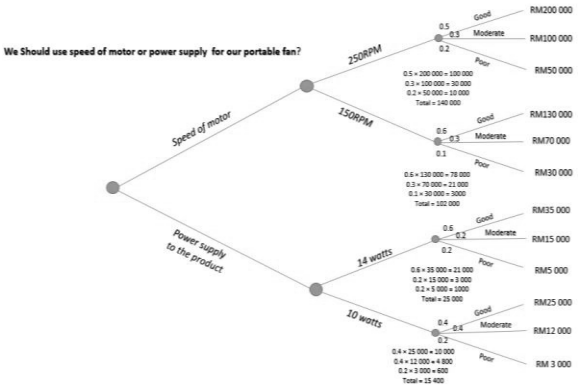
5.6.1 Decision Tree Analysis

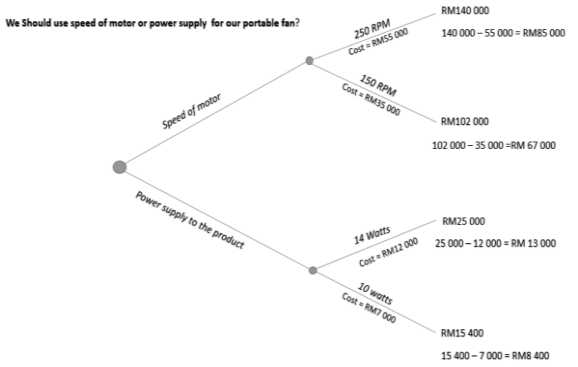




5.7 Portable Fan

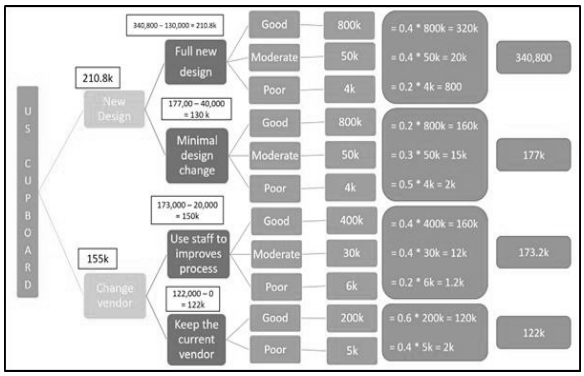
5.7.1 Decision Tree Analysis





5.8 Cupboard

5.8.1 Decision Tree Analysis



CHAPTER 6

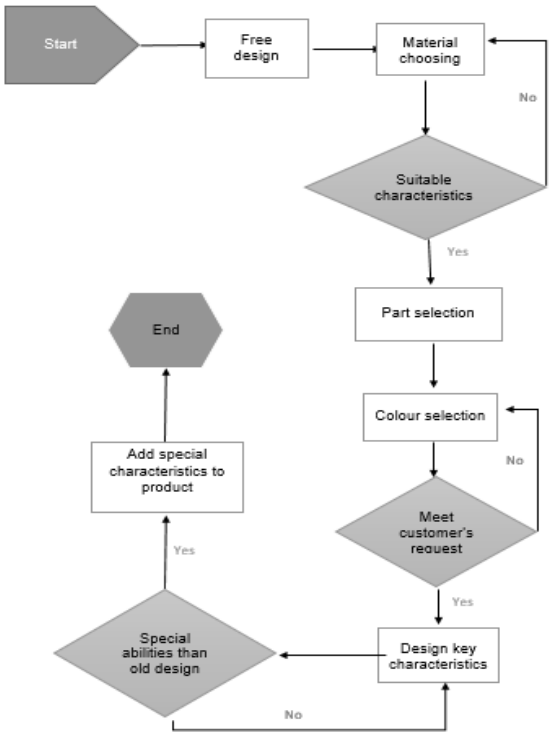
QUALITY AND PERFORMANCE

Outcome based Education:

1. Students are able to develop a flowchart of assemble process based on their product.
2. Students are able to develop a control chart in order to observe any abnormal data in the process.

6.1 Reversible Umbrella

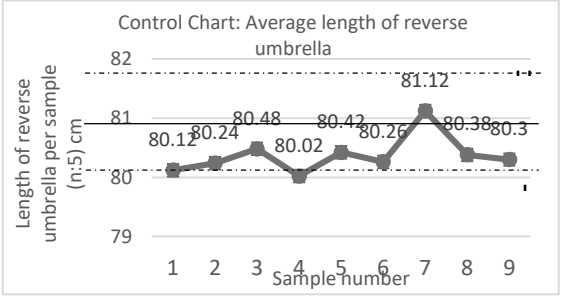
6.1.1 Flowchart Development



6.1.2 Control Chart Development

Subgroup	Sample (cm)								
	1	2	3	4	5	6	7	8	9
X1	80.1	80.0	81.2	79.7	81.2	80.0	81.5	80.3	89.7
X2	80.3	79.7	79.9	80.0	79.7	79.6	80.7	79.5	80.7
X3	80.4	80.5	80.6	80.1	80.0	80.6	81.2	81.0	81.1
X4	79.8	81.1	80.0	80.5	80.5	81.2	81.3	80.2	79.8
X5	80.0	79.9	80.7	79.8	80.7	79.9	80.9	80.9	80.2
Average	80.12	80.24	80.48	80.02	80.42	80.26	81.12	80.38	80.30
Range	0.6	1.4	1.3	0.8	1.5	1.6	0.8	1.4	1.4

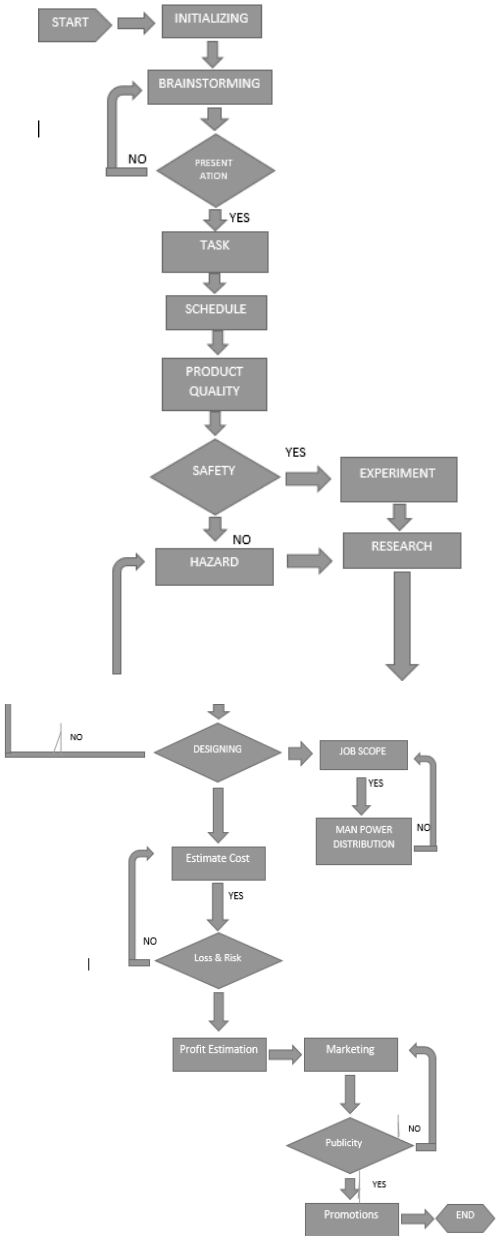
Grand Mean= (723.34)/9 = 80.37
Average Range= (10.8)/9 = 1.2
UCL= 80.37 + (0.577) (1.2) = 81.0624
LCL = 80.37 – (0.577) (1.2) = 79.6776



At sample number 7, the average length exceeds the UCL by 81.12cm. We use fish bone diagram to find the root cause and to provide the suitable counter measure to solve it. From the fish bone diagram, the root caused are from the material. The material provided by the supplier didn't meet with our quality standards requirement. So we asked our Inventory to only accept the material that meet with our standards and reject any defect material given by our supplier.

6.2 Bell-Shaped Umbrella

6.2.1 Flowchart Development



6.2.2 Control Chart Development

Table of the length of umbrella shaft (cm)

1) GRAND X BAR

$\frac{2280.84}{30} = 76.03CM$

2) AVERAGE RANGE

$\frac{173.3}{30} = 5.78CM$

3) UCL FOR X BAR

(76.03) + ((0.308)(5.78)) = 77.81CM

4) LCL FOR X BAR

(76.03) – ((0.308)(5.78)) = 74.25CM

5) UCL FOR RANGE

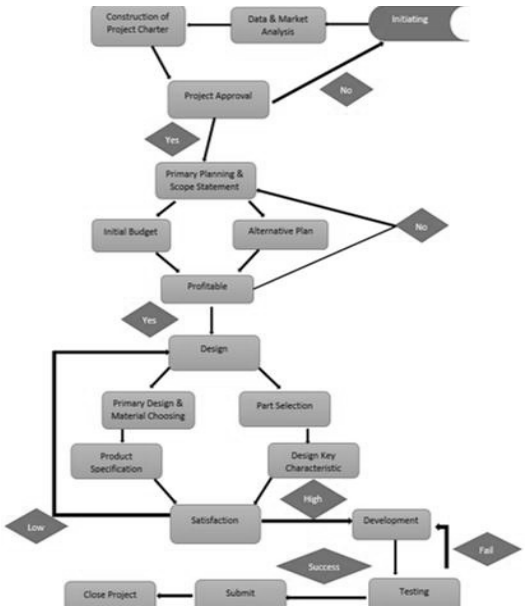
(1.777)(5.78) = 10.27CM

6) LCL FOR RANGE

(0.223) (5.78) = 1.29CM

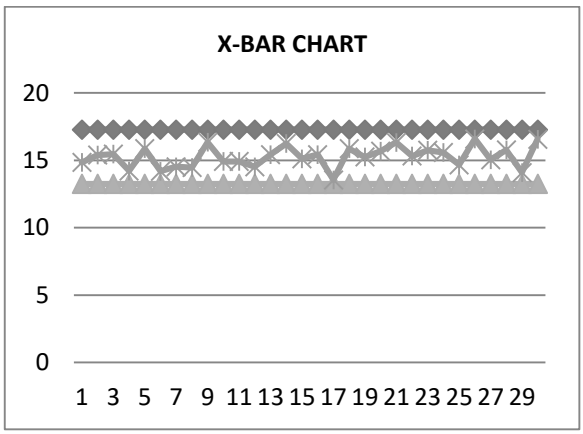
6.3 Hair Dryer

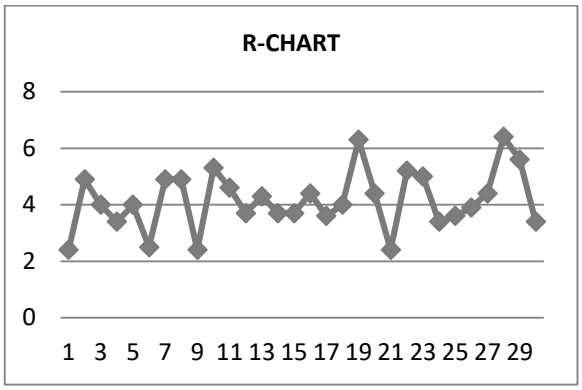
6.3.1 Flowchart Development



6.3.2 Control Chart Development

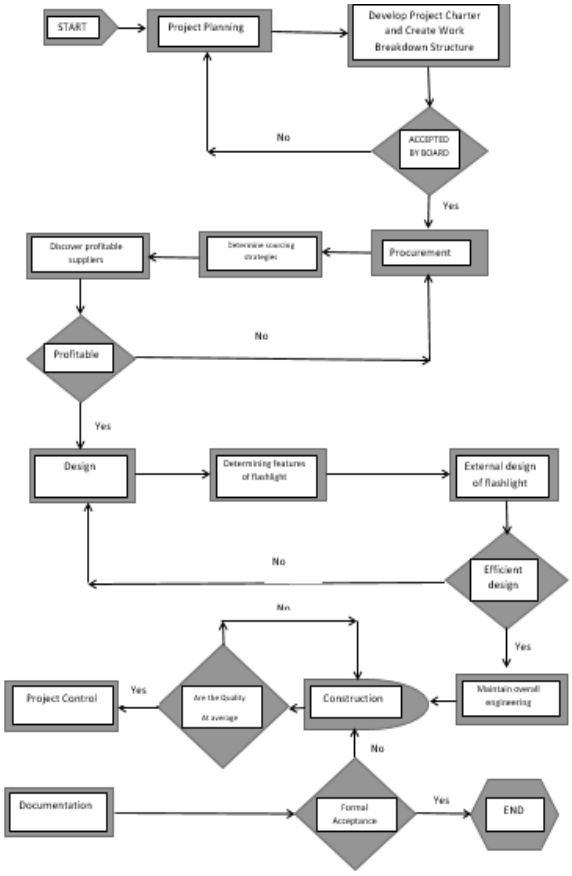
Sub group	X1	X2	X3	X4	X5	X6	Average	Range
1	14.5	15.1	13.8	14.2	15.3	16.2	14.85	2.4
2	16.4	15.7	16.8	14.0	17.2	12.3	15.40	4.9
3	17.1	16.9	15.2	13.8	13.1	16.7	15.47	4.0
4	14.1	13.4	12.3	15.6	14.2	15.7	14.22	3.4
5	16.7	13.2	17.1	16.9	14.1	17.2	15.87	4.0
6	15.1	12.9	13.3	14.8	13.7	15.4	14.20	2.5
7	13.4	12.5	16.3	17.0	12.1	15.9	14.53	4.9
8	12.0	15.1	16.9	14.5	16.2	12.1	14.47	4.9
9	15.1	17.3	16.2	15.4	16.6	17.5	16.35	2.4
10	14.9	12.4	15.8	16.3	17.7	12.4	14.92	5.3
11	13.4	12.5	14.5	17.1	15.7	16.3	14.92	4.6
12	15.9	16.6	12.9	13.4	14.5	13.9	14.53	3.7
13	16.1	14.4	15.1	13.0	17.3	16.7	15.43	4.3
14	14.7	15.1	16.5	15.6	17.2	18.4	16.25	3.7
15	13.6	14.7	15.2	13.8	17.3	16.1	15.12	3.7
16	14.9	15.5	17.8	13.4	16.7	14.3	15.43	4.4
17	15.8	13.3	14.1	12.9	13.0	12.2	13.55	3.6
18	14.1	13.7	17.1	15.9	16.7	17.7	15.87	4.0
19	13.1	14.9	15.8	12.1	17.2	18.4	15.25	6.3
20	14.7	13.4	17.5	16.0	17.8	14.7	15.68	4.4
21	15.3	16.2	17.7	15.8	17.2	15.8	16.33	2.4
22	16.8	17.5	12.3	13.6	14.4	17.3	15.32	5.2
23	15.9	16.7	17.7	14.9	16.6	12.7	15.75	5.0
24	13.8	14.9	15.2	15.6	17.2	16.8	15.58	3.4
25	14.9	16.3	14.2	15.6	14.3	12.7	14.67	3.6
26	16.8	15.9	17.9	18.4	16.1	14.5	16.60	3.9
27	13.7	14.6	12.7	15.7	17.1	16.5	15.05	4.4
28	12.1	14.9	16.3	14.7	18.5	18.2	15.78	6.4
29	13.6	14.5	14.9	17.3	18.1	19.2	14.10	5.6
30	14.7	15.1	16.5	17.4	17.6	18.1	16.57	3.4
						SUM	458.06	124.70





6.4 Touch Light

6.4.1 Flowchart Development



6.4.2 Control Chart Development

The X-Bar (arithmetic mean) and R (range) Control Chart is used with variables data when subgroup or sample size is between 2 and 15.

Step 1- Determine the data to be collected.
Decide what questions about the process you plan to answer.

Step 2- Collect the data by subgroup.
A subgroup is made up of variables data that represent a characteristic of a product produced by a process. The sample size relates to how large the subgroups are.

Subgroup	1	2	3	4
x_1	10.3	9.4	10.3	10.1
x_2	10.9	10.5	10.1	9.8
x_3	10.1	10.8	10.3	11.1
x_4	10.2	10.6	13.5	10.6
x_5	11.4	9.9	9.9	10.4
Average	10.58	10.24	10.82	10.40

5	6	7	8	9
10.3	9.4	10.6	11.0	9.0
11.4	10.3	11.4	10.8	10.2
12.2	9.9	10.3	11.4	8.6
10.5	12.5	10.3	11.4	10.0
10.5	10.1	10.0	10.3	10.0
10.98	10.44	10.52	10.98	9.56

Step 3- Calculate the average for each subgroup.
Use the formula below to calculate the average (mean) for each subgroup and enter it on the line labelled Average in the data collection section.

$$\bar{x} = \frac{x_1 + x_2 + x_3 + \cdots x_n}{n}$$

Where:
$\bar{x}$ = The average of the measurements within each subgroup
x_i = The individual measurements within a subgroup
n = The number of measurements within a subgroup

$$\bar{x} = \frac{10.3 + 10.9 + 10.1 + 10.2 + 11.4}{5}$$
$$= \frac{52.9}{5} = 10.58$$

Step 4- Calculate the range for each subgroup.
Use the following formula to calculate the range (R) for each subgroup.

RANGE = (Largest Value in each Subgroup) – (Smallest Value in each Subgroup)

Subgroup	1	2	3	4
x_1	10.3	9.4	10.3	10.1
x_2	10.9	10.5	10.1	9.8
x_3	10.1	10.8	10.3	11.1
x_4	10.2	10.6	13.5	10.6
x_5	11.4	9.9	9.9	10.4
Average	8.5	8.66	9.44	9.12
Range	1.3	1.4	3.6	1.3

Subgroups becomes the centreline for the lower plotting area.

5	6	7	8	9
10.3	9.4	10.6	11.0	9.0
11.4	10.3	11.4	10.8	10.2
12.2	9.9	10.3	11.4	8.6
10.5	12.5	10.3	11.4	10.0
10.5	10.1	10.0	10.3	10.0
9.88	9.62	9.92	10.52	9.36
1.9	3.1	1.4	1.1	1.6

Step 5- Calculate the grand mean of the subgroup's average.

$$\bar{\bar{x}} = \frac{8.50+8.66+9.44+9.12+9.88+9.62+9.92+10.52+9.36}{9}$$
$$= 9.45$$

Step 6- Calculate the average of the subgroup ranges. The average of all subgroups becomes the centreline for the lower plotting area.

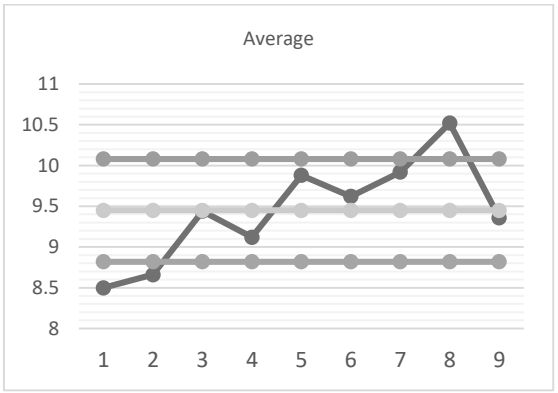
$$\bar{R} = \frac{1.3+1.4+3.6+1.3+1.9+3.1+1.4+1.1+1.6}{9}$$
$$= \frac{16.7}{9}$$
$$= 1.856$$
$$= 1.86$$

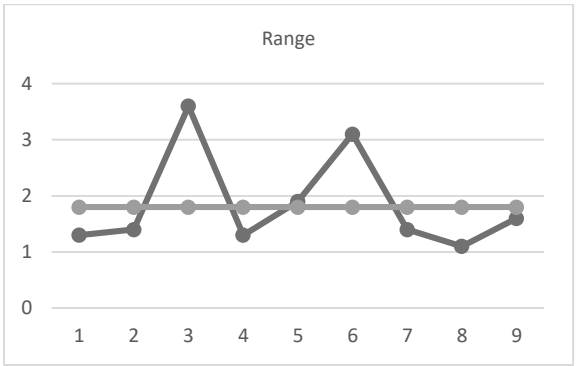
Step 7- Calculate the upper control limit (UCL) and lower control limit (LCL).

Control limits define the parameters for determining whether a process is in statistical control. To find the X-Bar control limits, use the following formula:

$UCL_{\bar{x}}$ =9.45+0.337(1.86)
=10.08
$LCL_{\bar{x}}$ =9.45-0.337(1.86)
=8.82

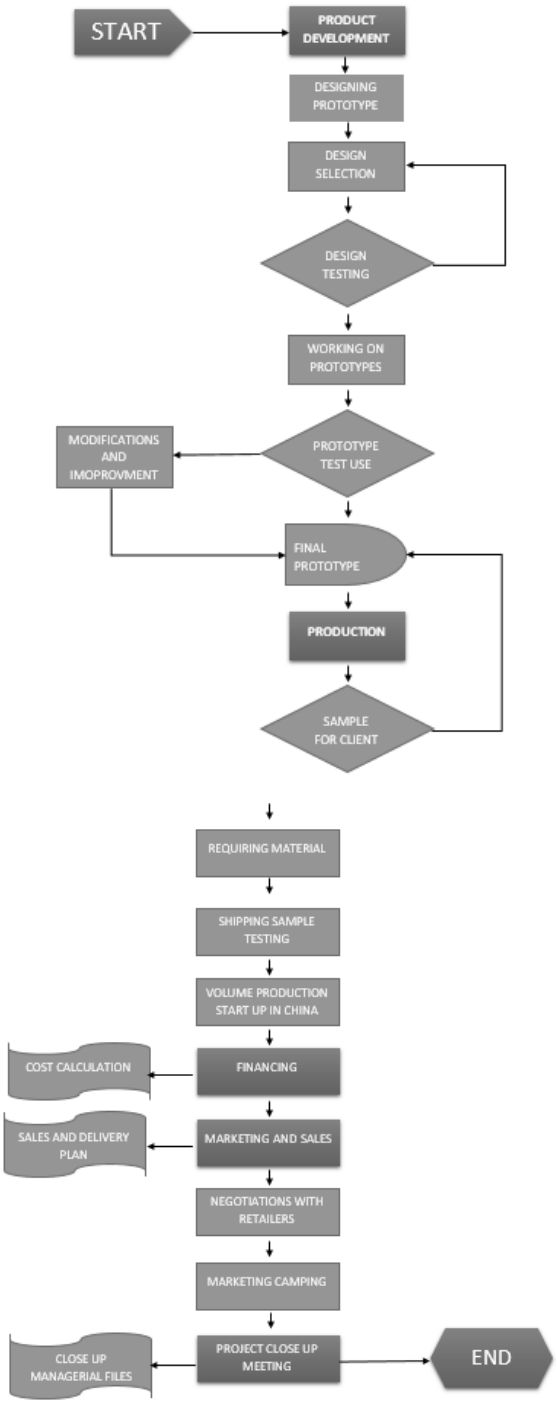
Step 8- Provide the appropriate documentation. Each Control Chart should be labelled with who, what, when, where, why, and how information to describe where the data originated, when it was collected, who collected it, any identifiable equipment or work groups, sample size, and all the other things necessary for understanding and interpreting it.





6.5 USB Fan

6.5.1 Flowchart Development



6.5.2 Control Chart Development

The X-Bar (arithmetic mean) R(range) Control Chart is used with variables data when subgroup or sample size is between 2 and 15.

STEP 1 - Determine the data to be collected.
STEP 2 - Collect the data by subgroup.
STEP 3 - Calculate the average for each subgroup.
STEP 4 - Calculate the range for each subgroup.
STEP 5 - Calculate the grand mean of the subgroups average.
STEP 6 - Calculate the average of the subgroups ranges.
STEP 7 - Calculate the upper control limit (UCL) and the lower control limit (LCL).
STEP 8 – Provide the appropriate documentation.

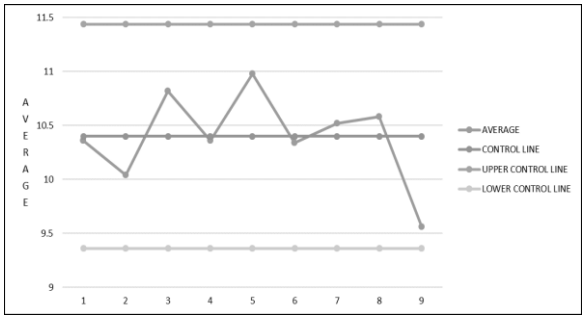
Average for each subgroup

Subgroup	1	2	3	4	5	6	7	8	9
X_1	**10.30**	9.40	10.30	10.00	10.30	9.90	10.60	9.00	9.00
X_2	**9.90**	10.50	10.10	9.80	11.40	10.30	11.40	10.80	10.20
X_3	**10.00**	9.80	10.30	11.00	12.20	9.90	10.30	11.40	8.60
X_4	**10.20**	10.60	13.50	10.60	10.50	11.50	10.30	11.40	10.00
X_5	**11.40**	9.90	9.90	10.40	10.50	10.10	10.00	10.30	10.00
Average	**10.36**	10.04	10.82	10.36	10.98	10.34	10.52	10.58	9.56

$$\overline{\overline{X}} = \frac{10.30+9.90+10.00+10.20+11.40}{5}$$

$=10.36$

$UCL_{\overline{X}} = \overline{\overline{X}} + A_2\overline{R} = (10.40) + (0.577)(1.8) = 11.4386$
$LCL_{\overline{X}} = \overline{\overline{X}} - A2\overline{R} = (10.40) - (0.577)(1.8) = 9.3614$



Range for each subgroup

Subgroup	1	2	3	4	5	6	7	8	9
X_1	10.30	9.40	10.30	10.00	10.30	9.90	10.60	9.00	9.00
X_2	9.90	10.50	10.10	9.80	11.40	10.30	11.40	10.80	10.20
X_3	10.00	9.80	10.30	11.00	12.20	9.90	10.30	11.40	8.60
X_4	10.20	10.60	13.50	10.60	10.50	11.50	10.30	11.40	10.00
X_5	11.40	9.90	9.90	10.40	10.50	10.10	10.00	10.30	10.00
Average	10.36	10.04	10.82	10.36	10.98	10.34	10.52	10.58	9.56
Range	1.5	1.2	3.6	1.2	1.9	1.6	1.4	2.4	1.6

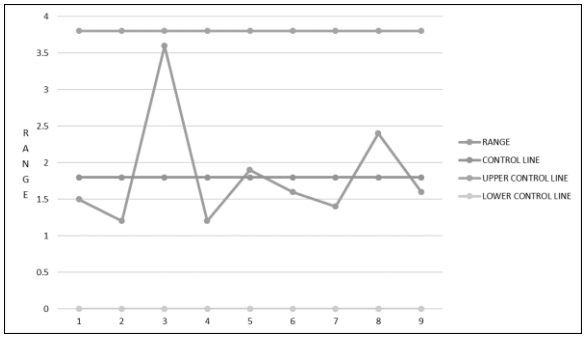
$$\overline{\overline{X}} = \frac{10.36+10.04+10.82+10.36+10.98+10.34+10.52+10.58+9.56}{9}$$

$=10.40$

$$\overline{R} = \frac{1.5+1.2+3.6+1.2+1.9+1.6+1.4+2.4+1.6}{9}$$

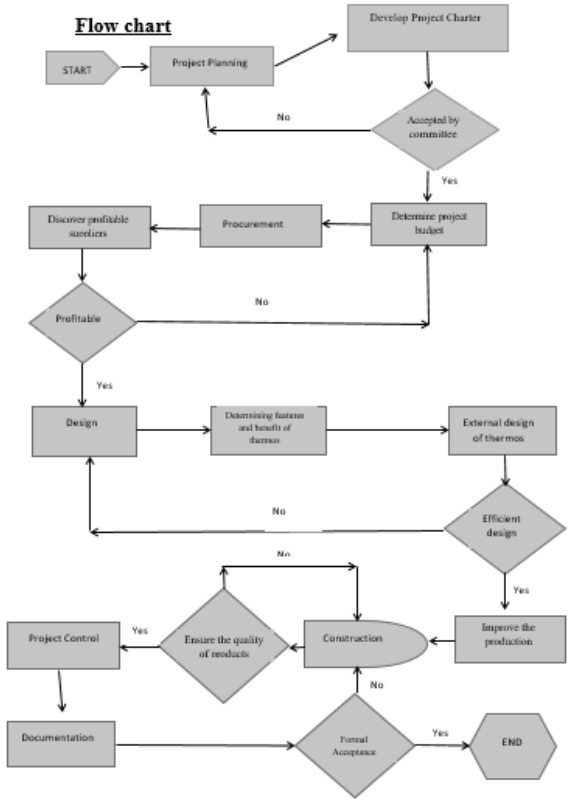
$= 1.8$

$UCL_{\overline{R}} = D_4 \times \overline{R} = 2.114 \times 1.8 = 3.8052$
$LCL_{\overline{R}} = D_3 \times \overline{R} = 0 \times 1.8 = 0$



6.6 Thermos Flask

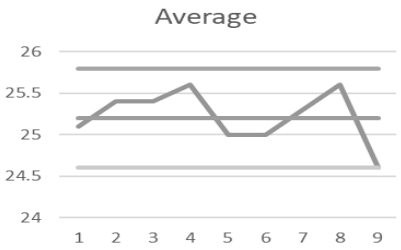
6.6.1 Flowchart Development

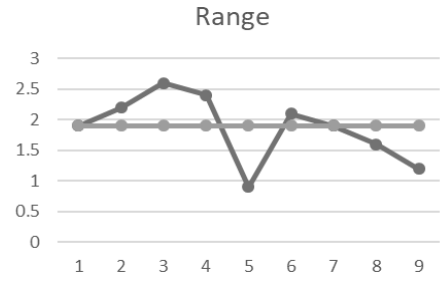


6.6.2 Control Chart Development

Subgroup	1	2	3	4
x_1	25.1	25.4	25.3	26.1
x_2	24.9	25.5	25.1	26.8
x_3	26.1	26.8	24.3	25.1
x_4	24.2	24.6	25.5	25.6
x_5	25.4	24.9	26.9	24.4
Average	25.1	25.4	25.4	25.6
Range	1.9	2.2	2.6	2.4

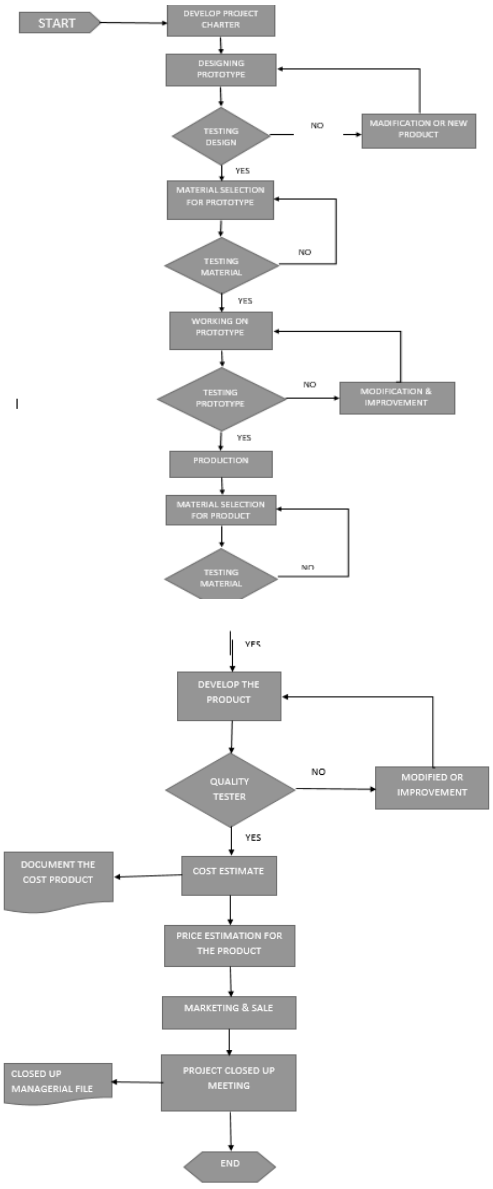
5	6	7	8	9
25.3	26.4	25.6	25.0	24.0
25.4	24.3	24.4	24.8	25.2
25.2	24.9	25.3	26.4	24.6
24.5	24.5	26.3	26.4	25.0
24.5	25.1	25.0	25.3	24.0
25.0	25.0	25.3	25.6	24.6
0.9	2.1	1.9	1.6	1.2





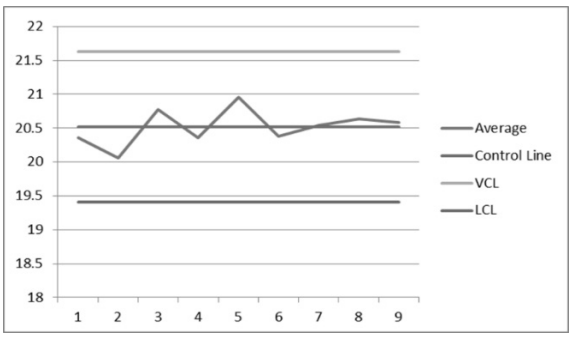
6.7 Portable Fan

6.7.1 Flowchart Development

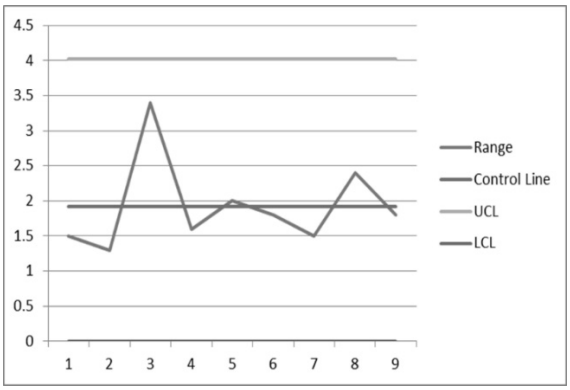


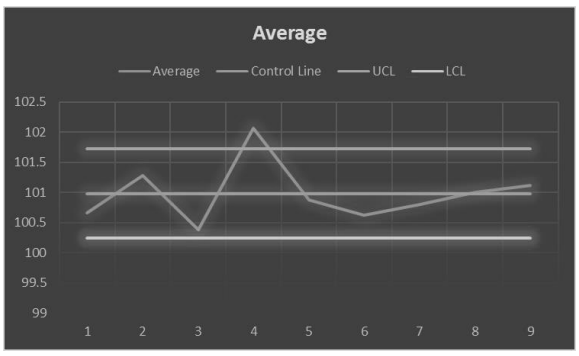
6.7.2 Control Chart Development

Subgroup	1	2	3	4	5	6	7	8	9
X1	**20.1**	19.3	20.3	20.0	21.2	19.9	21.1	21.4	20.6
X2	**20.0**	19.9	22.4	19.6	22.3	20.1	20.6	21.3	21.0
X3	**19.9**	20.6	20.8	21.2	20.3	21.7	19.8	20.8	20.9
X4	**20.4**	20.0	21.4	20.5	20.4	20.0	19.9	20.7	19.3
X5	**21.4**	20.5	19.0	20.5	20.6	20.2	21.3	19.0	21.1
Average	**20.36**	20.06	20.78	20.36	20.96	20.38	20.54	20.64	20.58

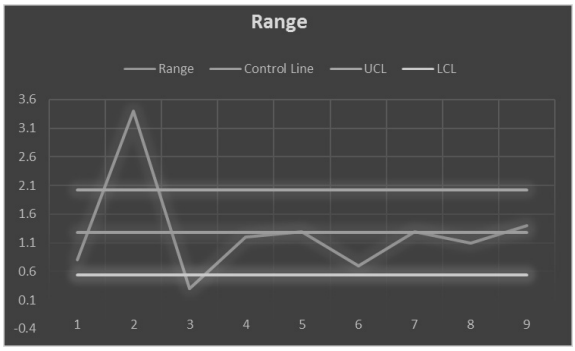


X_1	20.1	19.3	20.3	20.00	21.2	19.9	21.1	21.4	20.6
X_2	20.0	19.9	22.4	19.6	22.3	20.1	20.6	21.3	21.0
X_3	19.9	20.6	20.8	21.2	20.3	21.7	19.8	20.8	20.9
X_4	20.4	20.0	21.4	20.5	20.4	20.0	19.9	20.7	19.3
X_5	21.4	20.5	19.0	20.5	20.6	20.2	21.3	19.0	21.1
Average	20.36	20.06	20.78	20.36	20.96	20.38	20.54	20.64	20.58
Range	1.5	1.3	3.4	1.6	2.0	1.8	1.5	2.4	1.8



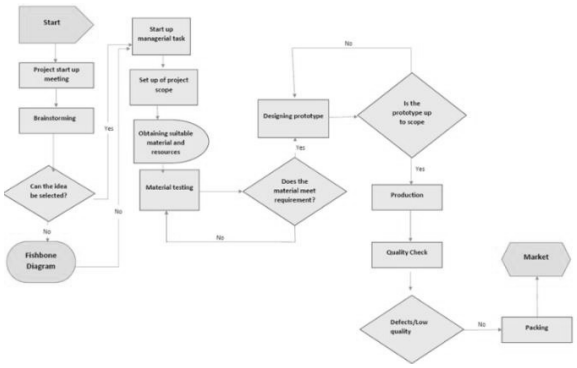


Subgroup	1	2	3	4	5	6	7	8	9
x1	100.5	100.3	100.6	101.5	101.6	100.3	100.5	100.6	100.9
x2	101.1	102.6	100.3	102.1	100.5	100.6	100.9	100.5	101.9
x3	100.9	101.5	100.3	102.3	100.7	100.3	101.7	101.5	101.8
x4	100.3	100.4	100.4	102.7	100.3	100.9	100.5	100.8	100.5
x5	100.5	101.6	100.3	101.7	101.3	101	100.4	101.6	100.5
Range	0.8	3.4	0.3	1.2	1.3	0.7	1.3	1.1	1.4



6.8 Cupboard

6.8.1 Flowchart Development



6.8.2 Control Chart Development

Subgroup	1	2	3	4	5	6	7	8	9
x1	100.5	100.3	100.6	101.5	101.6	100.3	100.5	100.6	100.9
x2	101.1	102.6	100.3	102.1	100.5	100.6	100.9	100.5	101.9
x3	100.9	101.5	100.3	102.3	100.7	100.3	101.7	101.5	101.8
x4	100.3	100.4	100.4	102.7	100.3	100.9	100.5	100.8	100.5
x5	100.5	101.6	100.3	101.7	101.3	101	100.4	101.6	100.5
Average	100.66	101.28	100.38	102.06	100.88	100.62	100.8	101	101.12

CHAPTER 7

SCHEDULING

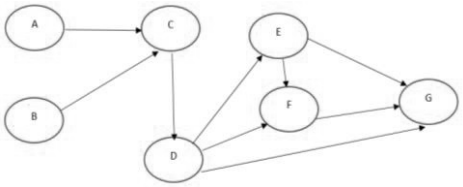
Outcome based Education:

1. Students are able to construct activity on node (AON) and activity on arrow (AOA) based on their product flowchart.
2. Students are able to perform critical path method (CPM) in order to determine the total duration required for those critical activities.

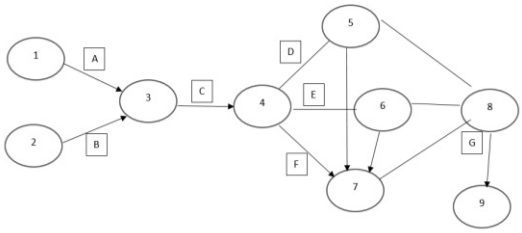
7.1 Reversible Umbrella

Activities	Predecessor	Duration (Days)
A - Design	-	10
B - Primary Design	-	2
C - Material Choosing	A , B	2
D - Part Selection	C	2
E - Colour Selection	D	2
F - Product Specification	D , E	2
G - Design Key Characteristic	D , E , F	1

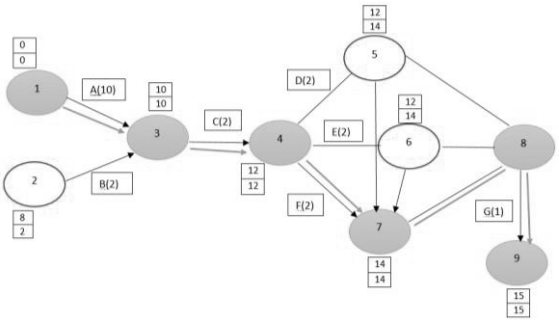
7.1.1 Activity on Node (AON)



7.1.1 Activity on Arrow (AOA)



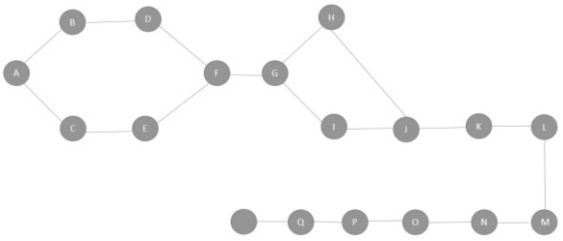
7.1.2 CPM Analysis



7.2 Bell-Shaped Umbrella

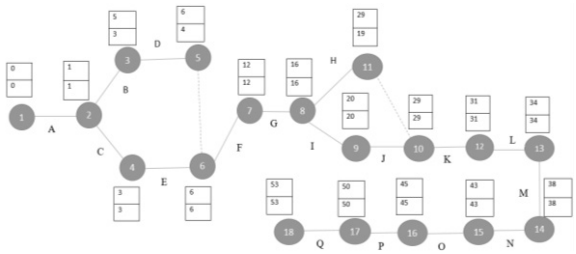
ACTIVITY	PREDESSOR	DURATION
A	-	1
B	A	3
C	A	2
D	B	1
E	C	3
F	D,E	6
G	F	4
H	G	3
I	G	4
J	H,I	9
K	J	2
L	K	3
M	L	4
N	M	5
O	N	2
P	O	5
Q	P	3

7.2.1 Activity on Node (AON)



7.2.1 Activity on Arrow (AOA)

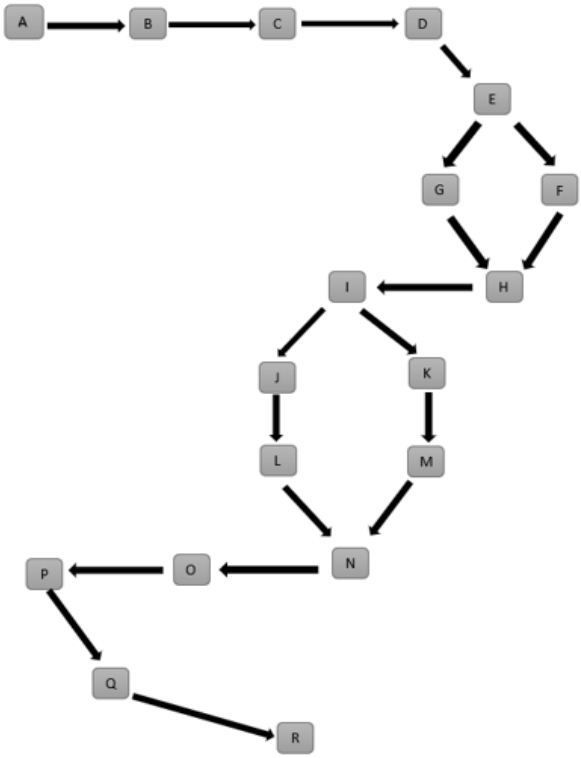
7.2.2 CPM Analysis



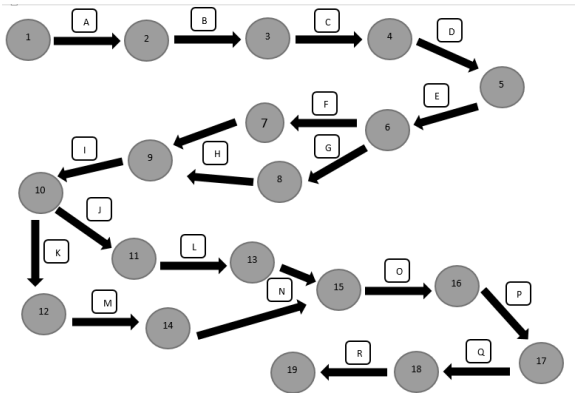
7.3 Hair Dryer

NAME	ACTIVITY	PREDECESSOR	DAY
Initiating	A	_	8
Data & Market Analysis	B	A	8
Construction of Project Charter	C	B	2
Project Approval	D	C	1
Primary Planning & Scope Statement	E	D	4
Initial Budget	F	E	4
Alternative Plan	G	E	11
Profitable	H	F,G	1
Design	I	H	5
Primary Design & Material Choosing	J	I	3
Part Selection	K	I	4
Product Specification	L	J	4
Design Key Specification	M	K	2
Satisfaction	N	L,M	1
Development	O	N	21
Testing	P	O	25
Submit	Q	P	3
Close Project	R	Q	3

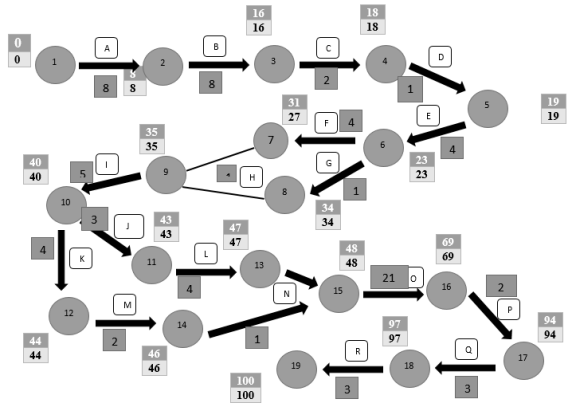
7.3.1 Activity on Node (AON)



7.3.1 Activity on Arrow (AOA)



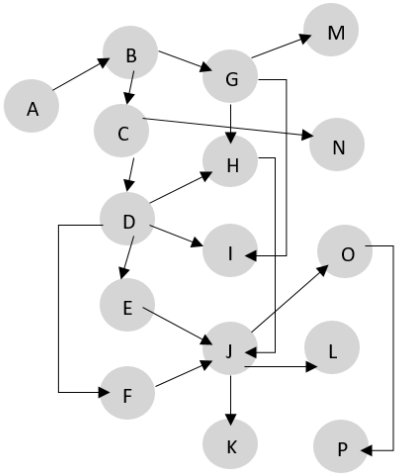
7.3.2 CPM Analysis



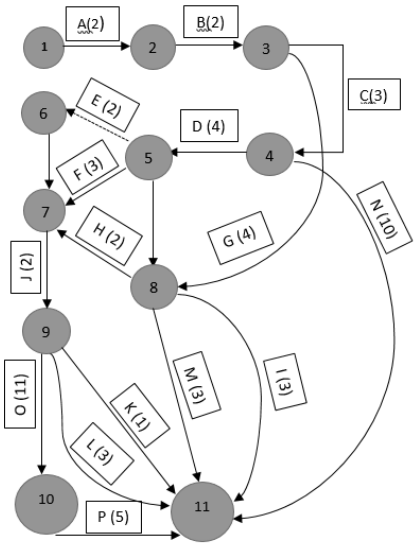
7.4 Touch Light

Activity	Predecessor	Day
A	-	2
B	A	2
C	B	2
D	C	2
E	D	2
F	D	3
G	B	4
H	G, D	2
I	G, D	3
J	E, F,H	2
K	J	1
L	J	3
M	G	3
N	C	10
O	J	11
P	O	5

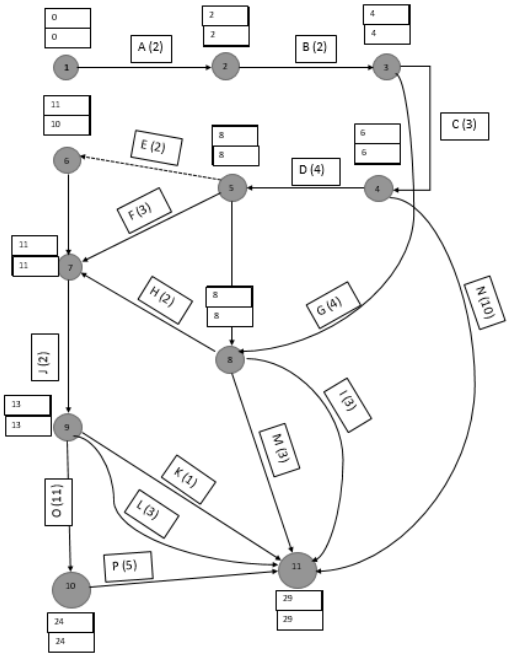
7.4.1 Activity on Node (AON)



7.4.1 Activity on Arrow (AOA)



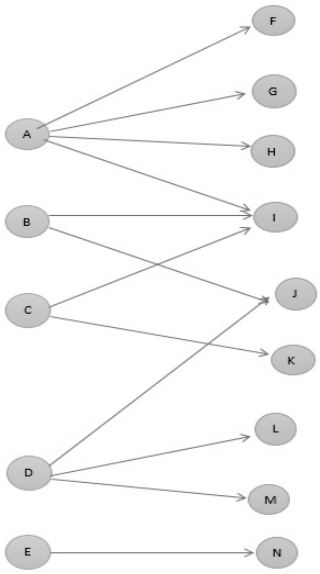
7.4.2 CPM Analysis



7.5 USB Fan

Activity	Predecessor
A. Product Development	-
B. Production	-
C. Financing	-
D. Marketing and Sales	-
E. Project Close Up Meeting	-
F. Design Prototype	A
G. Design Selection	A
H. Design Testing	A
I. Requiring Material	A, B, C
J. Shipping Material	B, D
K. Cost Calculation	C
L. Sales and Delivery Plan	D
M. Marketing Camping	D
N. Close Up	E

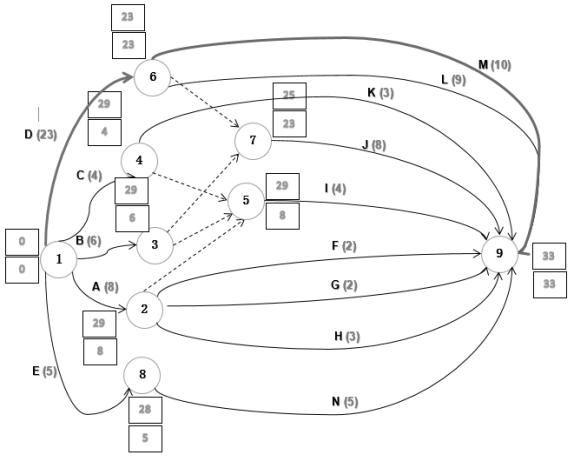
7.5.1 Activity on Node (AON)



7.5.1 Activity on Arrow (AOA)

7.5.2 CPM Analysis

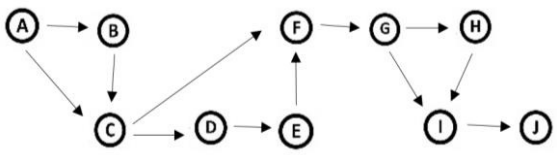
Activity	Predecessor	Duration
A. Product Development	-	8
B. Production	-	6
C. Financing	-	4
D. Marketing and Sales	-	23
E. Project Close Up Meeting	-	5
F. Design Prototype	A	2
G. Design Selection	A	2
H. Design Testing	A	3
I. Requiring Material	A, B, C	4
J. Shipping Material	B, D	8
K. Cost Calculation	C	3
L. Sales and Delivery Plan	D	9
M. Marketing Camping	D	10
N. Close Up	E	5



7.6 Thermos Flask

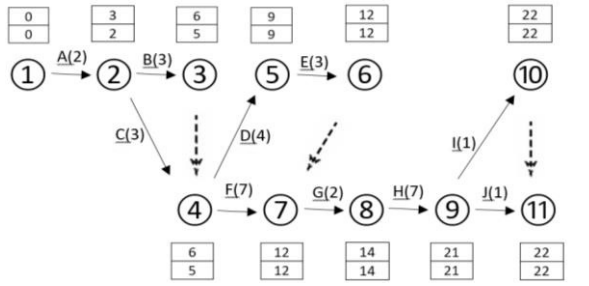
Activities	Pre-requisite Activities	Duration
Project planning (A)	-	2
Develop project charter (B)	A	3
Accepted by committee (C)	A,B	3
Determine project budget (D)	C	4
Discover profitable suppliers (E)	D	3
Profitable (F)	C,E	7
Design (G)	F	2
External design of thermos (H)	G	7
Efficient design (I)	G,H	1
Construction (J)	I	1

7.6.1 Activity on Node (AON)



7.6.1 Activity on Arrow (AOA)

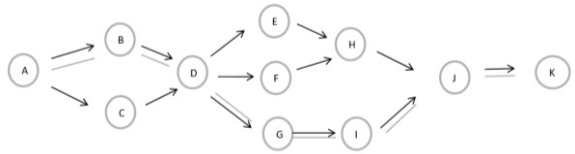
7.6.2 CPM Analysis



7.7 Portable Fan

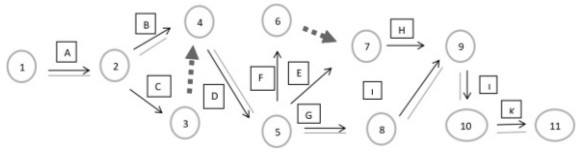
	Activity	Predecessor	Duration
A	Develop project charter	-	1
B	Designing Prototype	A	3
C	Material Selection for Prototype	A	2
D	Working on Prototype	B , C	4
E	Production	D	3
F	Material Selection for Production	D	2
G	Develop the Product	D	6
H	Cost Estimate	E , F	1
I	Price Estimation for The Product	G	2
J	Marketing and Sale	H , I	3
K	Project Closed Up Marketing	S	1

7.7.1 Activity on Node (AON)



7.7.1 Activity on Arrow (AOA)

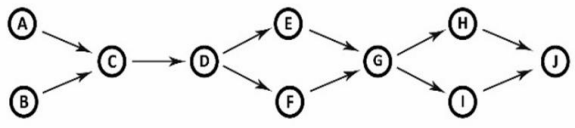
7.7.2 CPM Analysis



7.8 Cupboard

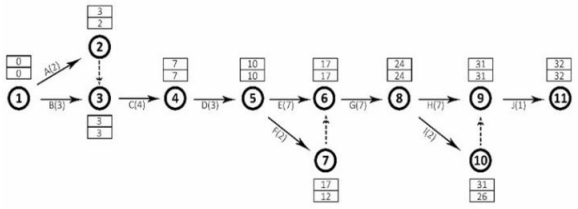
Activities	Prerequisite Activities	Duration
Project Start Up Meeting (A)	-	2
Start Up Managerial Tasks (B)	-	3
Brainstorming (C)	A, B	4
Set Up Project Scope (D)	C	3
Ordering Material (E)	D	7
Material Testing (F)	D	2
Designing Prototype (G)	E, F	7
Production (H)	G	7
Quality Check (I)	G	2
Packing (J)	H,I	1

7.8.1 Activity on Node (AON)



7.8.1 Activity on Arrow (AOA)

7.8.2 CPM Analysis



CHAPTER 8

CRASHING PROJECT

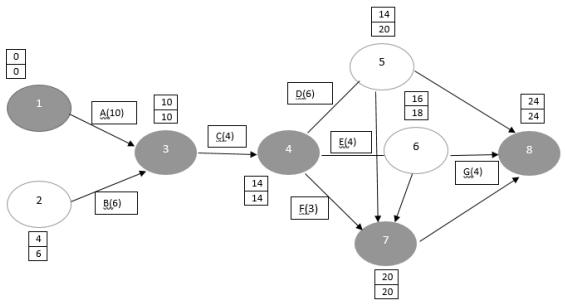
Outcome based Education:

1. Students are able to perform program evaluation and review technique (PERT) when the duration is expected as optimistic, most-likely and pessimistic.
2. Students are able to crash the project when it is necessary.

8.1 Reversible Umbrella

8.1.1 PERT Analysis

ACTIVITY	PREDECESSOR	OPTIMISTIC, a	MOST LIKELY, m	PESSIMISTIC, b
A-Design	-	6	10	14
B-Primary Design	-	4	6	8
C-Material Choosing	A,B	2	4	6
D-Part Selection	C	4	5	12
E-Colour Selection	D	1	4	7
F-Product Specification	D,E	1	2	9
G-Design Key Characteristic	D,E,F	2	3	10



ACTIVITY	EXPECTED DURATION, t_e	VARIANCE, σ^2
A-Design	10	1.778
B-Primary Design	6	0.444
C-Material Choosing	4	0.444
D-Part Selection	6	1.778
E-Colour Selection	4	1
F-Product Specification	3	1.778
G-Design Key Characteristic	4	1.778

CRITICAL PATH = A(10) – C(4) – F(3) – G(4)

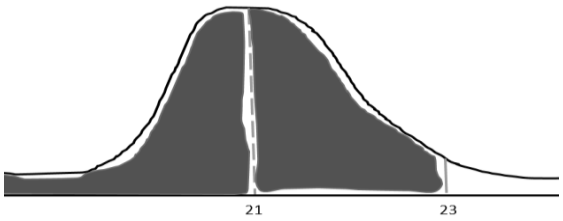
ACTIVITY	EXPECTED DURATION, t_e	VARIANCE
A-Design	10	1.778
C-Material Choosing	4	0.444
F-Product Specification	3	1.778
G-Design Key Characteristic	4	1.778
TOTAL	21	5.778

Expectation work done (%) less than 23:

$= \frac{23-21}{2.40}$

= 0.83

= 0.7967/ 79%

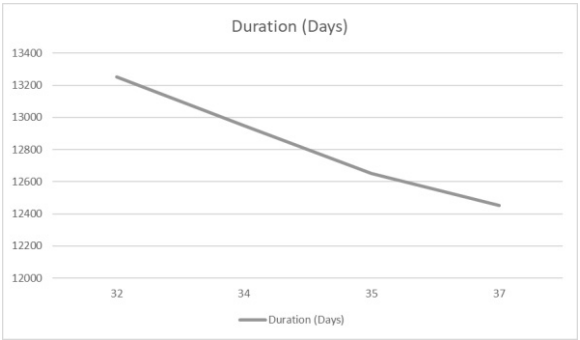


8.1.2 Crashing Project

	Normal		Crashed	
ACTIVITY	Duration (Days)	Cost (RM)	Duration (Days)	Cost (RM)
A	10	1000	10	1000
B	6	700	5	900
C	4	2400	4	2400
D	6	1500	4	1800
E	4	1100	4	1100
F	3	2250	3	2250
G	4	3500	2	3800

Activity	Crashing cost (per day)
A	-
B	200
C	-
D	150
E	-
F	-
G	150

Activity Crashed	Duration (Days)	Total Cost (RM)
None Crashed	37	12450
B crashed	35	12650
B + D crashed	34	12950
B + D + G crashed	32	13250



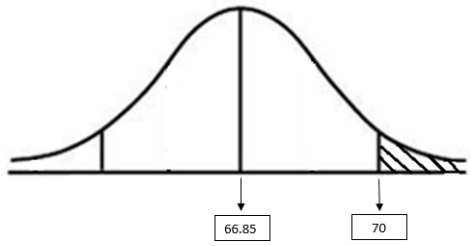
8.2 Bell-Shaped Umbrella

8.2.1 PERT Analysis

ACTIVITY	OPTIMISTIC	MOST LIKELY	PESSIMISTIC	EXPECTED TIME	VARIANCE
A	1	2	3	1.33	0.11
C	2	3	5	3.17	0.25
E	3	5	7	5	0.44
F	6	7	8	7	0.11
G	4	5	7	5.17	0.25
I	4	5	7	5.17	0.25
J	9	10	11	6.67	0.11
K	2	3	5	3.17	0.25
L	3	4	6	4.17	0.25
M	4	5	7	5.17	0.25
N	5	6	7	6	0.03
O	2	3	5	3.17	0.25
P	5	7	8	6.83	0.25
Q	3	5	6	4.83	0.25
TOTAL	53			66.85	3.05

i. Condition of more than

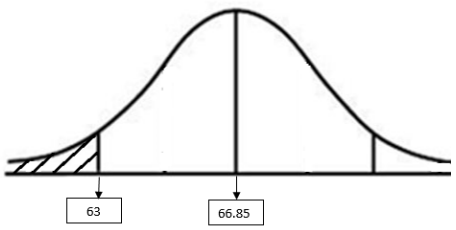
$$\frac{(70-66.85)}{1.75} = 1.8 \quad \boxed{\begin{matrix}0.9641\\96.41\%\end{matrix}}$$



Thus, 96.41% of the data are above week 70

ii. Condition of less than

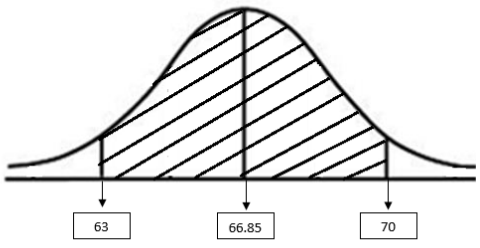
$$\frac{(63-66.85)}{1.75} = -2.2 \quad \boxed{\begin{matrix}0.0139\\1.39\%\end{matrix}}$$



Thus, 1.39% of the data are less than week 63

iii. Condition of in between

$$\frac{X_1 - X_2}{0.9641 - 0.0140} = 0.9502 \text{ or } 95.02\%$$



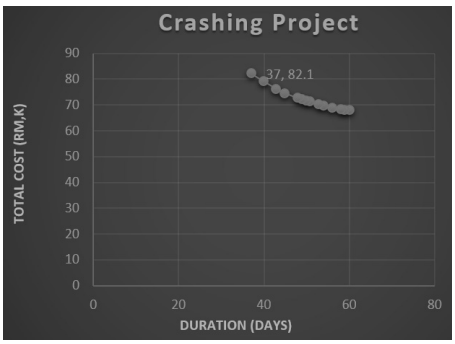
Thus, 95.02% of the data are between week 63 and week 70

8.2.2 Crashing Project

ACTIVITY	Normal		Crashed	
	DURATION (DAYS)	COST (RM)	DUATION (DAYS)	COST (RM)
A	1	1000	1	2000
B	3	4000	2	4500
C	2	2000	1	2200
D	1	500	1	800
E	3	3000	1	3800
F	6	5500	3	7600
G	4	4500	2	5500
H	3	3500	1	5000
I	4	4500	3	5000
J	9	10000	8	10500
K	2	2500	1	2500
L	3	3750	2	4000
M	4	4250	2	4750
N	5	5500	2	8500
O	2	2500	1	2500
P	5	7000	2	12000
Q	3	3570	2	4250

ACTIVITY	CRASHING COST (per day)
A	-
B	500
C	200
D	-
E	400
F	700
G	500
H	750
I	500
J	500
K	-
L	250
M	250
N	1000
O	-
P	1000
Q	500

Activity Crashed	Duration (days)	Total Cost (RM)
None Crashed	60	67750
C	59	67950
C+L	58	68200
C+L+M	56	68700
C+L+M+E	54	69500
C+L+M+E+G	52	70500
C+L+M+E+G+I	51	71000
C+L+M+E+G+I+J	50	71500
C+L+M+E+G+I+J+Q	49	72000
C+L+M+E+G+I+J+Q+F	46	74100
C+L+M+E+G+I+J+Q+F+N	43	77100
C+L+M+E+G+I+J+Q+F+N+P	40	80100



8.3 Hair Dryer

8.3.1 PERT Analysis

ACTIVITY	OPTIMISTIC	MOST LIKELY	PESSIMISTIC	EXPECTED TIME	VARIANCE
A	8	9	10	9	0.11
B	8	9	10	9	0.11
C	2	3	4	3	0.11
D	1	2	3	2	0.11
E	4	3	5	4	0.03
F	4	5	6	5	0.11
G	11	12	14	12	0.11
H	1	2	3	2	0.25
I	5	4	9	5	0.44
J	3	4	6	4	0.25
K	4	3	5	4	0.03
L	4	5	5	5	0.03
M	2	3	5	3	0.25
N	1	3	4	3	0.25
O	21	20	23	21	0.11
P	25	26	28	26	0.25
Q	3	4	7	4	0.44
R	3	4	6	4	0.25

Critical Path:
A, B, C, D, E, G, H, I, J, L, N, O, P, Q, R

ACTIVITY	EXPECTED TIME	VARIANCE
A	9	0.11
B	9	0.11
C	3	0.11
D	2	0.11
E	4	0.03
G	12	0.11
H	2	0.25
I	5	0.44
J	4	0.25
L	5	0.03
N	3	0.25
O	21	0.11
P	26	0.25
Q	4	0.44
R	4	0.25
SUM	113	2.85

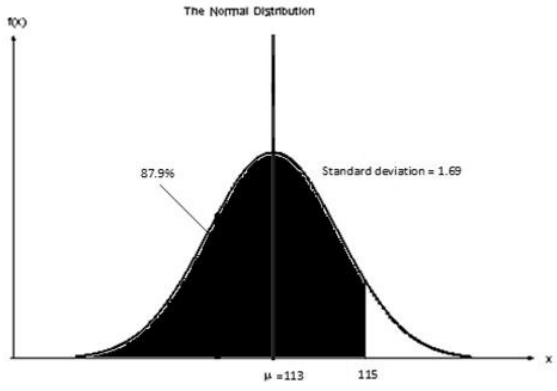
More than,

$= \frac{115-113}{1.69}$

=1.1834

=0.8790

=87.9



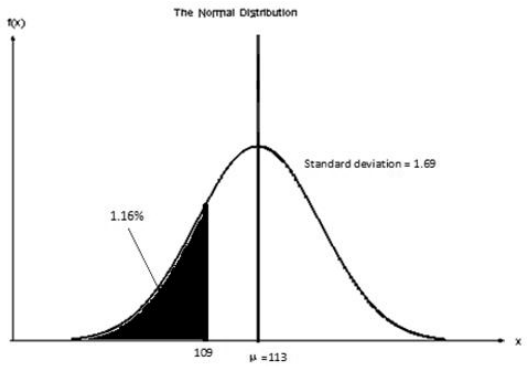
Less Than

$= \frac{109-113}{1.69}$

= 2.3669

=0.0116

=1.16%



In Between,

111 - 116

$= \frac{111-113}{1.69}$

=-1.1834

=0.1190

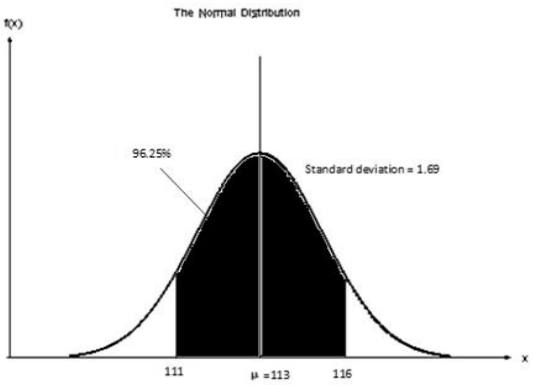
=11.9%

$= \frac{116-113}{1.69}$

= 1.7751

= 0.9625

= 96.25%

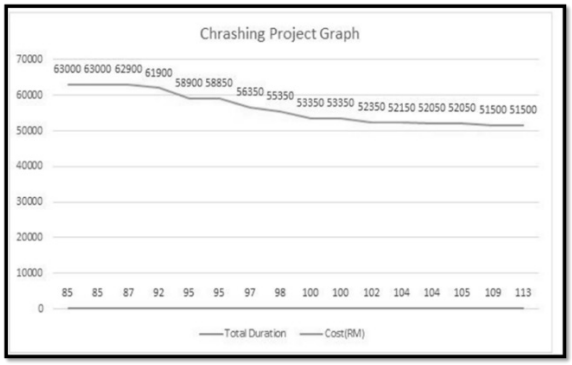


8.3.2 Crashing Project

Activities	Normal		Crashed	
	Duration (Days)	Cost (RM)	Duration (Days)	Cost (RM)
Initiating (A)	8	500	4	500
Data & Market Analysis (B)	8	1000	4	1500
Construction of Project Charter (C)	2	200	1	250
Project Approval (D)	1	400	1	500
Primary Planning & Scope Statement (E)	4	2000	2	2200
Initial Budget(F)	4	3000	2	3200
Alternative Plan (G)	11	5000	9	6000
Profitable (H)	1	1000	1	1000
Design (I)	5	9000	3	11000
Primary Design & Material Choosing (J)	3	5000	2	6000
Part Selection (K)	4	600	2	800
Product Specification (L)	4	5000	2	7500
Design Key Specification (M)	2	4000	2	4500
Satisfaction (N)	1	300	1	350
Development (O)	21	12000	18	15000
Testing (P)	25	2000	20	3000
Submit (Q)	3	500	1	600
Close Project (R)	3	0	2	0

Activities	Crash Test (Per Days)
Initiating (A)	0
Data & Market Analysis (B)	500
Construction of Project Charter (C)	50
Project Approval (D)	100
Primary Planning & Scope Statement (E)	200
Initial Budget (F)	200
Alternative Plan (G)	1000
Profitable (H)	0
Design (I)	2000
Primary Design & Material Choosing (J)	1000
Part Selection (K)	200
Product Specification (L)	2500
Design Key Specification (M)	500
Satisfaction (N)	50
Development (O)	3000
Testing (P)	1000
Submit (Q)	100
Close Project (R)	0

Activities Crashed	Total Duration	Cost (RM)
None Crashed	113	51500
A Crashed	109	51500
A,B Crashed	105	52050
A,B,C Crashed	104	52050
A,B,C,D Crashed	104	52150
A,B,C,D,E Crashed	102	52350
A,B,C,D,E,G Crashed	100	53350
A,B,C,D,E,G,H Crashed	100	53350
A,B,C,D,E,G,H,I Crashed	98	55350
A,B,C,D,E,G,H,I,J Crashed	97	56350
A,B,C,D,E,G,H,I,J,L Crashed	95	58850
A,B,C,D,E,G,H,I,J,L,N Crashed	95	58900
A,B,C,D,E,G,H,I,J,L,N,O Crashed	92	61900
A,B,C,D,E,G,H,I,J,L,N,O,P Crashed	87	62900
A,B,C,D,E,G,H,I,J,L,N,O,P,Q Crashed	85	63000
A,B,C,D,E,G,H,I,J,L,N,O,P,Q,R Crashed	85	63000



8.4 Touch Light

8.4.1 PERT Analysis

Critical path	Planned time, a	Pessimistic time, b	Most likely time, m	Expected duration, t_e	Variance, σ^2
A	2	6	1	2	0.444
B	2	5	2	3	0.250
C	3	8	2	3	0.694
D	4	7	3	4	0.250
F	3	9	2	3	1.000
J	2	5	2	3	0.250
O	11	17	10	11	1.000
P	5	8	4	5	0.250
Total	32	65	26	34	4.138

Less than 29 days,

$Z_1 : \frac{29-34}{2.03}$

= -2.46

=0.00695

= 0.70%

In between 29 and 38 days,

$Z_1 : \frac{29-34}{2.03}$ $Z_2 : \frac{38-34}{2.03}$

= -2.46 = 1.97

=0.00695 =0.9756

P (29 < PD < 38) = 1 - 0.97558 - 0.00695

= 0.017

= 1.7%

More than 38 days,

$Z_1 = \frac{38-34}{2.03}$

$= 1.97$

$= 0.9756$

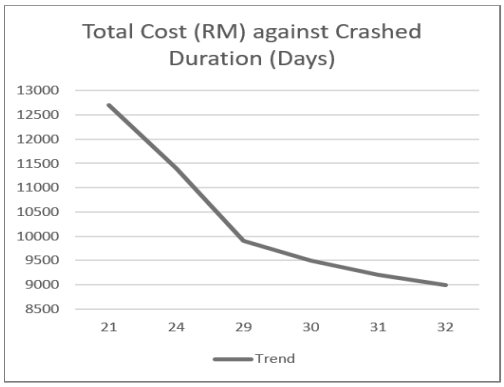
$= 97.56\%$

8.4.2 Crashing Project

Activity	Normal		Crash	
	Days	Cost (RM)	Days	Cost (RM)
A	2	1000	1	1400
B	2	1000	1	1500
C	3	700	2	1000
D	4	1600	4	1600
F	3	1500	1	2000
J	2	1000	1	1200
O	11	1200	8	2500
P	5	1000	3	1500

Activity	Crashing cost per day (RM)
A	40
B	500
C	300
D	-
F	500
J	200
O	1300
P	500

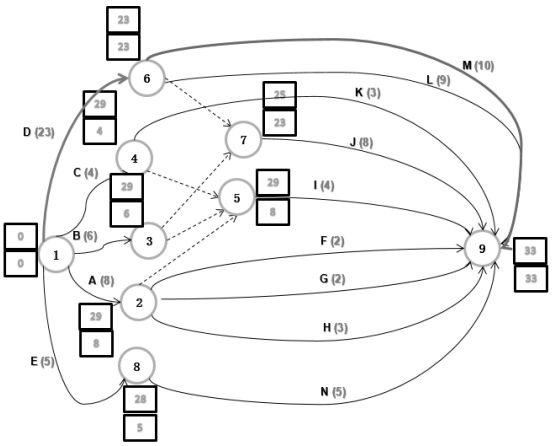
Activity Crashed	Duration (days)	Total Cost (RM)
None	32	9000
J crashed	31	9200
J+C crashed	30	9500
J+C+A crashed	29	9900
J+C+A+B+F+P crashed	24	11400
J+C+A+B+F+P+O crashed	21	12700



8.5 USB Fan

8.5.1 PERT Analysis

ACTIVITY	PREDECESSOR	OPTIMISTIC, a	MOST LIKELY, m	PESSIMISTIC, b
A. Product Development	-	6	8	10
B. Production	-	4	6	8
C. Financing	-	1	4	7
D. Marketing and Sales	-	22	23	24
E. Project Close Up Meeting	-	4	5	12
F. Design Prototype	A	1	2	9
G. Design Selection	A	1	2	3
H. Design Testing	A	2	3	10
I. Requiring Material	A, B, C	2	4	6
J. Shipping Material	B, D	6	8	10
K. Cost Calculation	C	2	3	10
L. Sales and Delivery Plan	D	2	9	10
M. Marketing Camping	D	8	10	12
N. Close Up	E	3	5	7



ACTIVITY	EXPECTED DURATION, te	VARIANCE, σ
A. Product Development	8	0.444
B. Production	6	0.444
C. Financing	4	1
D. Marketing and Sales	23	0.111
E. Project Close Up Meeting	6	1.778
F. Design Prototype	3	1.778
G. Design Selection	2	0.111
H. Design Testing	4	1.778
I. Requiring Material	4	0.444
J. Shipping Material	8	0.444
K. Cost Calculation	4	1.778
L. Sales and Delivery Plan	8	1.778
M. Marketing Camping	10	0.444
N. Close Up	5	0.444

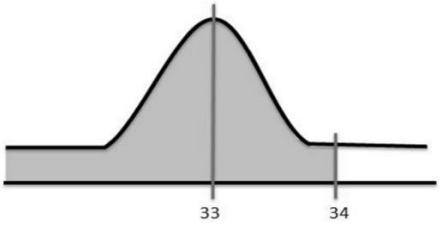
Probability work done before 34 weeks:

$= \sqrt{0.555} = 0.74$

$= \frac{34-33}{0.74}$

$= 1.35$

$= 0.9115/91\%$

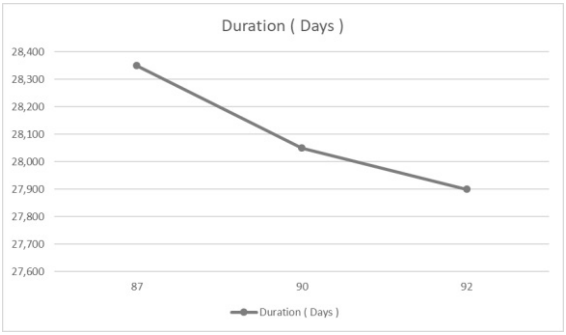


8.5.2 Crashing Project

Activity	Normal		Crashed	
	Durations (Days)	Cost (RM)	Duration (Days)	Cost (RM)
A	8	900	8	900
B	6	600	6	600
C	4	2400	4	2400
D	23	1400	20	1700
E	5	3650	5	3650
F	2	1500	2	1500
G	2	2300	2	2300
H	3	4500	3	4500
I	4	1000	4	1000
J	8	700	8	700
K	3	2500	3	2500
L	9	1100	9	1100
M	10	3750	8	3900
N	5	1600	5	1600

Activity	Crashing cost (per day)
A	-
B	-
C	-
D	100
E	-
F	-
G	-
H	-
I	-
J	-
K	-
L	-
M	75
N	-

Activity Crashed	Duration (days)	Total Cost (RM)
None crashed	92	27,900
M crashed	90	28,050
M + D crashed	87	28,350



8.6 Thermos Flask

8.6.1 PERT Analysis

Activities	Optimistic Time	Most Likely Time	Pessimistic Time
Project planning (A)	2	2	2
Develop project charter (B)	2	3	4
Accepted by committee (C)	2	3	4
Determine project budget (D)	2	4	4
Discover profitable suppliers (E)	2	3	4
Profitable (F)	6	7	8
Design (G)	1	2	3
External design of thermos (H)	6	7	7
Efficient design (I)	1	1	1
Construction (J)	1	1	2

Activity	Expected Time	Variance
A	2	0.0000
C	3	0.1111
F	7	0.0277
G	2	0.1111
H	7	0.0277
J	1	0.0277
Total,∑	22	0.3053

More than 23:
= (23-22)/0.5525
= 1.81
= 0.9649
= 96.49%

Less than 21:
= (21-22)/ 0.5525
= -1.81
= 0.0301
= 3.01%

In between 21 and 23:
= (23-22)/0.5525
= 1.81
= 0.9649
= 96.49%

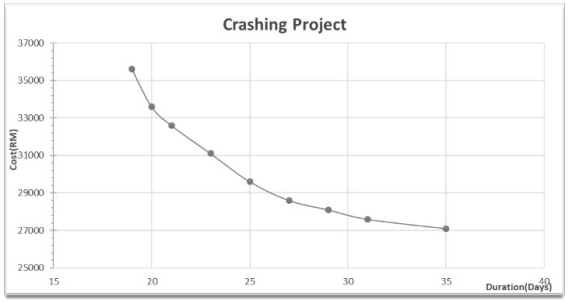
= (21-22)/ 0.5525
= -1.81
= 0.0301
= 3.01%

8.6.2 Crashing Project

Activities	NORMAL		CRASHED	
	Duration (days)	Cost (RM)	Duration (days)	Cost (RM)
Project Planning (A)	4	3500	2	4000
Develop project charter (B)	3	2000	1	2500
Accepted by committee (C)	3	500	1	1500
Determine project budget (D)	4	100	2	1600
Discover profitable suppliers (E)	3	2000	2	4000
Profitable (F)	7	5500	5	7000
Design (G)	2	3000	1	4000
External design of thermos (H)	7	1500	3	2000
Efficient design (I)	1	2000	1	2000
Construction (J)	1	7000	1	7000

Activity	Crashing point (per day)
A	250
B	250
C	500
D	750
E	2000
F	750
G	1000
H	125
I	0
J	0

Activity Crashed	Duration (days)	Total Cost ($)
Non crashed	35	27100
H crashed	31	27600
H+A crashed	29	28100
H+A+B crashed	27	28600
H+A+B+C crashed	25	29600
H+A+B+C+D crashed	23	31100
H+A+B+C+D+F crashed	21	32600
H+A+B+C+D+F+G crashed	20	33600
H+A+B+C+D+F+G+E crashed	19	35600



8.7 Portable Fan

8.7.1 PERT Analysis

Activity	Optimistic (a)	Most Likely (m)	Pessimistic (b)
Develop project charter (A)	1	1	2
Designing Prototype (B)	2	3	4
Material Selection for Prototype (C)	1	2	3
Working on Prototype (D)	2	4	5
Production (E)	2	3	5
Material Selection for Production (F)	1	2	3
Develop the Product (G)	4	6	8
Cost Estimate (H)	1	1	2
Price Estimation of The Product (I)	1	2	3
Marketing and Sale (J)	2	3	5
Project Closed Up Marketing (K)	1	1	2

Activity	Expected Time	Variance of Time
Develop project charter (A)	1.167	0.0278
Designing Prototype (B)	3	0.1111
Working on Prototype (D)	3.833	0.2500
Develop the Product (G)	6	0.4444
Price Estimation of The Product (I)	2	0.1111
Marketing and Sale (J)	3.167	0.2500
Project Closed Up Marketing (K)	1.167	0.0278
Total	20.334	1.2222

LESS THAN

$\frac{17-20}{1.1055}$

= -2.714

= 0.0034

= 3 %

MORE THAN

$\frac{23-20}{1.1055}$

= 2.714

= 0.9966

= 100 %

IN BETWEEN

$\frac{18-20}{1.1055}$

= - 1.809

= 0.0351

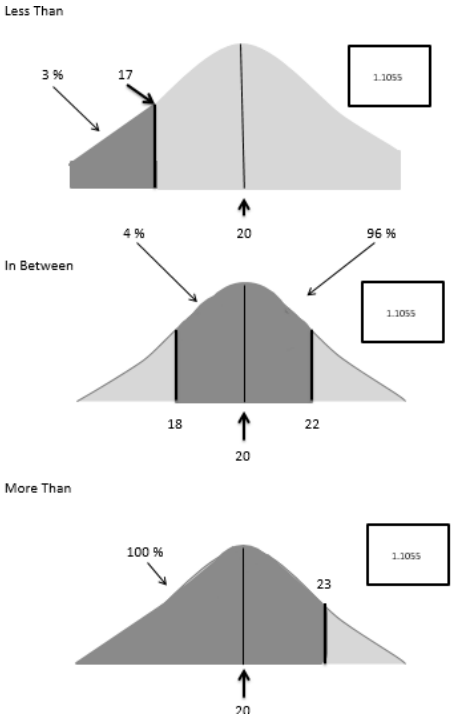
= 4 %

$\frac{22-20}{1.1055}$

= 1.809

= 0.9649

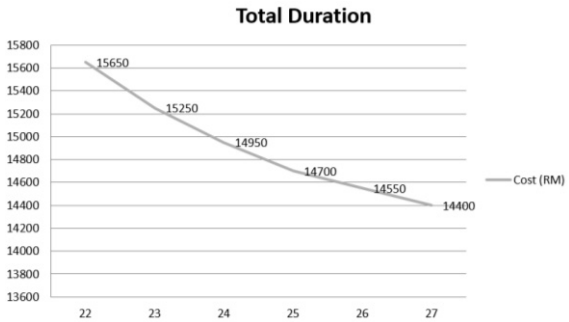
= 96 %



8.7.2 Crashing Project

Activity	Normal		Crashed	
	Duration (Days)	Cost (RM)	Duration (Days)	Cost (RM)
Develop project charter (A)	1	500	1	500
Designing Prototype (B)	3	750	2	900
Material Selection for Prototype (C)	2	550	1	600
Working on Prototype (D)	4	800	3	950
Production (E)	3	1000	2	1300
Material Selection for Production (F)	2	900	1	1100
Develop the Product (G)	6	1500	4	2000
Cost Estimate (H)	1	3000	1	3000
Price Estimation of The Product (I)	2	1700	1	2000
Marketing and Sale (J)	3	2500	2	2900
Project Closed Up Marketing (K)	1	1200	1	1200

Activity Crashed	Total duration	Cost (RM)
None Crashed	28	14400
B Crashed	27	14550
B + D Crashed	26	14700
B + D + G Crashed	24	14950
B + D + G + I Crashed	23	15250
B + D + G + I + J Crashed	22	15650



8.8 Cupboard

8.8.1 PERT Analysis

Activities	Optimistic Time	Most Likely Time	Pessimistic Time
Project Start Up Meeting (A)	1	3	2
Start Up Managerial Tasks (B)	1	3	3
Brainstorming (C)	2	4	4
Set Up Project Scope (D)	1	5	3
Ordering Material (E)	5	10	7
Material Testing (F)	1	4	2
Designing Prototype (G)	5	10	7
Production (H)	6	10	7
Quality Check (I)	2	5	2
Packing (J)	1	3	1

Activities	Expected time	Variance of time
Project Start Up Meeting (A)	2	0.11
Start Up Managerial Tasks (B)	3	0.11
Brainstorming (C)	4	0.11
Set Up Project Scope (D)	3	0.44
Ordering Material (E)	7	0.694
Material Testing (F)	2	0.25
Designing Prototype (G)	7	0.695
Production (H)	7	0.44
Quality Check (I)	2	0.25
Packing (J)	1	0.11

Activities	Expected time	Variance of time
Start Up Managerial Tasks (B)	3	0.11
Brainstorming (C)	4	0.11
Set Up Project Scope (D)	3	0.44
Ordering Material (E)	7	0.694
Designing Prototype (G)	7	0.695
Production (H)	7	0.44
Packing (J)	1	0.11
Total, $\sum$	32	2.598

More than

$$= \frac{35-32}{1.61} = 1.863$$

$$= 0.9686$$

$$= 97\%$$

Less than

$$= \frac{29-32}{1.61} = -1.863$$

$$= 0.0314$$

$$= 3\%$$

In between

$30 - 34$

$$= \frac{30-32}{1.61}$$

$$= -1.24$$

$$= 0.1075$$

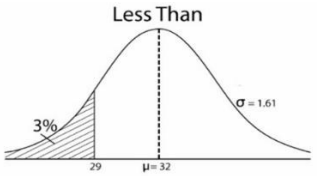
$$= 11\%$$

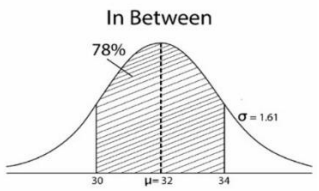
$$= \frac{34-32}{1.61}$$

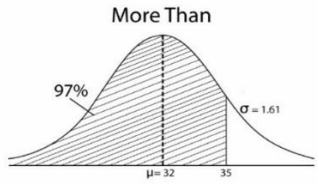
$$= 1.24$$

$$= 0.8925$$

$$= 89\%$$



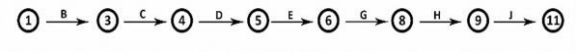




8.8.2 Crashing Project

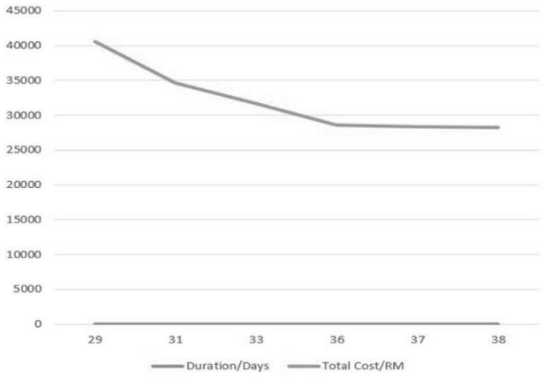
Activities	Normal		Crashed	
	Duration (Days)	Cost (RM)	Duration (Days)	Cost (RM)
Project Start Up Meeting (A)	2	500	2	500
Start Up Managerial Tasks (B)	3	750	2	1000
Brainstorming (C)	4	500	3	600
Set Up Project Scope (D)	3	1000	3	1000
Ordering Material (E)	7	7000	5	10000
Material Testing (F)	2	2000	1	3500
Designing Prototype (G)	7	5000	4	8000
Production (H)	7	8000	5	1400
Quality Check (I)	2	1500	1	2500
Packing (J)	1	2000	1	2000

Critical Path



Activities	Crash Test (Per Days)
Project Start Up Meeting (A)	-
Start Up Managerial Tasks (B)	250
Brainstorming (C)	100
Set Up Project Scope (D)	-
Ordering Material (E)	1500
Material Testing (F)	1500
Designing Prototype (G)	1000
Production (H)	3000
Quality Check (I)	1000
Packing (J)	-

Activities Crashed	Total Duration (Days)	Cost (RM)
None Crashed	38	28250
C crashed	37	28350
C + B crashed	36	28600
C + B + G crashed	33	31600
C + B + G + E crashed	31	34600
C + B + G + E + H crashed	29	40600



CHAPTER 9

EARNED VALUE ANALYSIS (EVA)

Outcome based Education:

1. Students are able to measure the performance of costs and schedules at any period during the progress of a project.

9.1 Reversible Umbrella

9.1.1 Measuring the Performance

We made a target for a total of 300 unit of reverse umbrella in 4 days period with budget being said as per day would cost a total of RM 180 and with a 75 unit of reverse umbrella being scheduled to be produce by a day. Our project should be finished in 4 days for a total of RM 720.

Day 1 progress:
1st batch (75 unit) produced, budget spent RM 180.
Day 2 progress:
2nd batch started, only produced 60, budget spent RM 190.
Day 3 progress:
2nd batch finished, 3rd batch only finished 3/5 (45 unit), left early, spent RM 158.

Term	Meaning and Formulae	Day 3 Values
PV- Planned Value	Estimated value of the work planned to be done	Should have done 3 x RM 180 = RM 540
EV- Earned Value	Estimated value of the work actually accomplished	Actually done 2.6 production. RM 180 + RM 180 + RM 108 = RM 468
AC- Actual Costs	Actual Costs incurred	RM 180 + RM 190 + RM 158 = RM 528
Cost Performance Index	CPI= EV/AC	RM 468/ RM 528 = 0.89 (Over budget)
Schedule Performance Index	SPI= EV/PV	RM 468/ RM 540 =0.87 (Behind Schedule)
BAC- Budget At Completion	Budgeted for total project	RM 720
EAC- Estimate At Completion	EAC = BAC/CPI	RM 720/ 0.89 = RM 808
ETC- Estimate to Complete	ETC= EAC - AC	RM 808 – 528 = RM 280
VAC- Variance At Completion	VAC= BAC - EAC	RM 720 – RM 808 = RM -88

9.2 Bell-Shaped Umbrella

9.2.1 Measuring the Performance

We need to complete our umbrella by the number of 700 in a week (7 days) with RM 700. We planned to complete 100 per day by RM100. On the fourth day, our progress:

1. Complete 100 with RM100
2. Complete 100 with RM105 (over budget)
3. Complete half only with RM 100
4. Continue the previous work and manage to finished the quarter of new work with RM 150

Term	Day 4 Values (RM)	Meaning
PV- Planed Value	Should have done 4x 100 = 400	-
EV- Earned Value	Actually done 3.25 x 100 = 325	-
AC- Actual Cost	100+105+100+150= 455	-
CPI-Cost Performance Index	EV/AC = 325/455= 0.71	Over budget
SPI-Schedule Performance Index	EV/PV= 325/400= 0.81	Behind Schedule
BAC-Budget At Completion	700	-
EAC- Estimate At Completion	BAC/CPI= 700/0.71= 985.92	Estimate RM985.92 to finished the whole project
ETC-Estimate To Complete	EAC-AC= 985.92-455= 530.92	Estimate RM530.92 to finish our project
VAC-Variance At Completion	BAC-EAC= 700-985.92= -285.92	RM285.92 over than we expect to do
CV-Cost Variance	EV-AC= 325-455= -130	Over Budget
SV-Schedule Variance	EV-PV= 325-400= -75	Behind Schedule

9.3 Hair Dryer

9.3.1 Measuring the Performance

In a hair dryer company, they estimate an activity of a major project for scalability of company offerings to last a week and cost RM45000 including hardware, the electronic component and assemble process. The RM 45000 is the baseline budget cost of the project. The budget at completion (BAC) is the baseline budgeted cost. The company wants to monitor the progress. It finds that at the end of the second day of the 5th day week, 15% of the work is complete and RM12000 has been spent. The planned activity had 25% completion at the end of the 2nd day.

Question	What should be used?	Formula	Solve
How much work is planned?	PV	PV= Planned Completion% * budget at completion	25% * RM12000 = RM3000
How much work is done already?	EV	EV = Actual Completion%* budget at completion	15% * RM12000 = RM1800
How much have we spent so far?	AC	-	RM 12000
What is the total cost of the project?	BAC	-	RM45000
What do we expect the total project completion cost at this time?	EAC	$EAC = \frac{AC*BAC}{EV}$	RM 300000
What is the estimate to complete the project?	ETC	ETC = EAC – AC	RM 288000
What is the future of this project?	VAC	VAC = BAC – EAC	-RM 255000
Cost Performance Index	CPI	$CPI = \frac{EV}{AC}$	0.15
Schedule Performance Index	SPI	$SPI = \frac{EV}{PV}$	0.6

Cost performance index (CPI) is the ratio of earned value to actual cost.
< 1 = over budget
> 1 = under budget

Schedule performance index (SPI) is the ratio of earned value to planned value.
< 1 = behind schedule
> 1 = ahead schedule

From the above statement,

CPI of our project is 0.15 while the SPI is 0.6. We can conclude that our project is already over budget and also behind the schedule.

9.4 Touch Light

9.4.1 Measuring the Performance

In a torchlight company, they estimate an activity of a major project for scalability of company offerings to last a week and cost RM20 000 including circuit plate and installation. The RM20 000 is the baseline budget cost of the project. The budget at completion (BAC) is the baseline budgeted cost. The company wants to monitor the progress. It finds that at the end of the second day of the 5th day week, 20% of the work is complete and RM 9 000 has been spent. The planned activity had 30% completion at the end of the 2nd day.

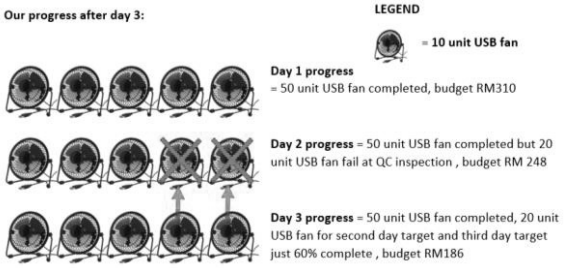
Question	What should be used?	Solve
How much work is planned?	PV	30% * RM 9 000 = RM 2 700
How much work is done already?	EV	20% * RM 9 000= RM 1 800
How much have we spent so far?	AC	RM 9 000
What is the total cost of the project?	BAC	RM 20 000
What do we expect the total project completion cost at this time?	EAC	RM 100 000
What is the estimate to complete the project?	ETC	RM 91 000
What is the future of this project?	VAC	-RM 80 000
Cost Performance Index	CPI	0.20
Schedule Performance Index	SPI	0.67

Since,
Cost performance index (CPI) is the ratio of earned value to actual cost.
< 1 = over budget
> 1 = under budget
Schedule performance index (SPI) is the ratio of earned value to planned value.
< 1 = behind schedule
> 1 = ahead schedule
Therefore,
Our project CPI and SPI is 0.2 and 0.67 respectively, which is consider over budget and behind the schedule already.

9.5 USB Fan

9.5.1 Measuring the Performance

We made a target for a total of 200 unit USB fans in four days period with budget being said as per day would cost a total of RM310 and with 50 unit USB fans being scheduled to be made by a day. Our project should be finished in 4 days for a total RM930.



Term	Meaning and Formulae	Day3 Values
Planned Value (PV)	Estimated value of the work Planned to be down	3xRM310= RM 930
Earned Value (EV)	Estimated value of the work that actually completed	RM310 + RM 310 +RM124 = RM 744
Actual Costs (AC)	Actually cost incurred	RM310 + RM 310 + RM 186 = RM 806
Cost Performance Index (CPI)	Over/Under budget factor (EV/AC)	RM744 / RM 806 = 0.92
Schedule Performance Index (SPI)	Ahead / behind schedule factor (EV/PV)	RM744/ RM 930 = 0.80
Budget at Completion (BAC)	Amounted budget for total project	4 x RM310 = RM 1240
Estimate At Completion (EAC)	Currently expected total for project (BAC/CPI)	RM1240 / 0.92= RM1348
Estimate to Complete (ETC)	How much more to finish (EAC-AC)	RM 1348 – RM 806 = RM542
Variance at Completion (VAC)	How much over/under we expect to be (BAC-EAC)	RM 1240 – RM 1348 = RM 108

9.6 Thermos Flask

9.6.1 Measuring the Performance

Budget of RM50 per Thermos bottle and schedule to produce 5000 Thermos bottles in 5 days. We should produce 1000 Thermos bottles per day for RM50,000.

Day 1 Progress:
1000 Thermos bottles produced, budget spent RM50,000.
Day 2 Progress:
Only 600 Thermos bottles produced, budget spent RM30,000.
Day 3 Progress:
Another 400 Thermos bottles for day 2 produced and 800 Thermos bottle produced, workers OT 4 hours (RM8 per hour x 500 workers), budget spent RM76,000.

Term	Day 3 Values
Planned Value (PV)	Should have done –RM50 x 3000 = RM150,000
Earned Value (EV)	Actual done 2800 Thermos Bottle - 2800 x RM50 = RM140,000
Actual Cost (AC)	RM50,000 + RM30,000 + RM76,000 = RM156,000
Cost Performance Index	$\frac{RM140,000}{RM156,000} = 0.9$
Schedule Performance Index	$\frac{RM140,000}{RM156,000} = 0.93$
Budget at Completion (BAC)	RM50 x 5000 = RM250,000
Estimate at Completion (EAC)	RM250,000÷0.9 = RM277,777.78
Estimate to Complete (ETC)	RM277,777.78 – RM156,000 = RM121777.78
Variance at Completion (VAC)	RM250,000 – RM277.777.78 = -RM27,777.78

9.7 Portable Fan

9.7.1 Measuring the Performance

Activity	Days	Cost	Actual Cost
Develop Project Team (A)	1	500	500
Designing Prototype (B)	3	750	800
Material Selection for Prototype (C)	2	550	560
Working on Prototype (D)	4	800	820
Production (E)	3	1000	1000
Material Selection for Production (F)	2	900	930
Develop the Product (G)	6	1500	1700
Cost Estimate (H)			
Price Estimation of The Product (I)	2	1700	
Marketing and Sale (J)	2	2500	
Project Closed Up Marketing (K)	1	1200	

Assuming 4 weeks for project until the end with budget RM 14 400.00.

Term	Week 3 Values Should Be Finish
PV – Planned Value	RM 6000
EV – Earned Value	Actually finish for 2 week and 6/7 of third - RM 4500 + RM 1200 = RM 5700
AC – Actual Costs	RM 4610 + RM 1300 = RM 5910
CPI – Cost Performance Index	EV / AC - RM 5700 / RM 5910 = 0.96
SPI – Schedule Performance Index	EV / PV - RM 5700 / RM 6000 = 0.95
BAC – Budget At Completion	RM 14400
EAC – Estimate At Completion	BAC / CPI - RM 14400 / 0.96 = RM 15000
ETC – Estimate At Completion	EAC – AC - RM 15000 – RM 5910 = RM 9090
VAC – Variance At Completion	BAC – EAC - RM 14400 – RM 15000 = -RM 600.00

9.8 Cupboard

9.8.1 Measuring the Performance

Budget is RM 700 per cupboard, 1 cupboard per day. Total cost RM4900. Finished in 7 days.

Day 1 = 1 and ½ =RM900.
Day 2 = ½ and 1 =RM800.
Day 3= ¼ cupboard, workers left early RM200, No electricity.
Day 4 = ¾ and 1 =RM1900.
Day 5= ½ cupboard workers left early because unsatisfied with late salary payment RM300.

Term	Cost (RM)
Planned Value, PV	5daysxrm700=RM3500
Earned Value, EV	RM3850
Actual Cost, AC	RM4100
Cost Performance Index, CPI	0.94
Schedule Performance Index, SPI	1.1
Budget at Completion, BAC	RM4900
Estimate at Completion, EAC	RM4900/0.94=RM5212.77
Estimate to Complete, ETC	RM1112.97
Variance at Completion, VAC	RM700 - RM512.77

CPI = 0.94 < 1, Over budget.
SPI = 1.1 >, Ahead of Tim